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ABSTRACT

Fourteen million students attend schools needing extensive repair or remodeling. It is estimated that U.S. schools will require as much as $112 billion to bring them up to a good overall condition and an additional $12 billion to comply with federal mandates. This book compiles what is considered the best maintenance and operations articles that have appeared in the journal "School Business Affairs, International" in recent years. The collection ranges from an overview of maintenance program management to specific maintenance projects such as recycling and pesticide use. Articles are categorized under the following broad topic areas: maintenance and operations management; contracting out maintenance services; energy management; security and safety; roofing; and environmental issues. (GR)

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Maintenance and Operations and the School Business Administrator

A Compilation of Articles from *School Business Affairs*

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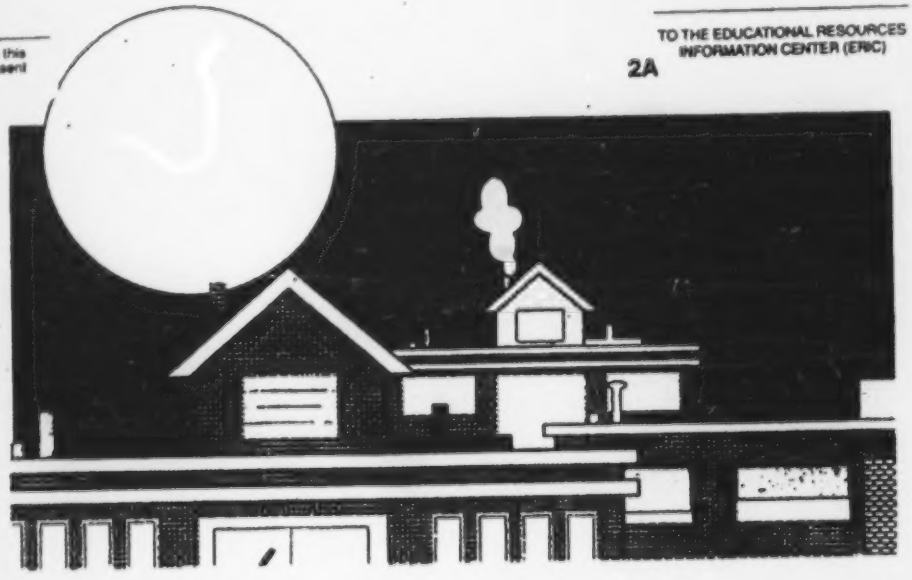

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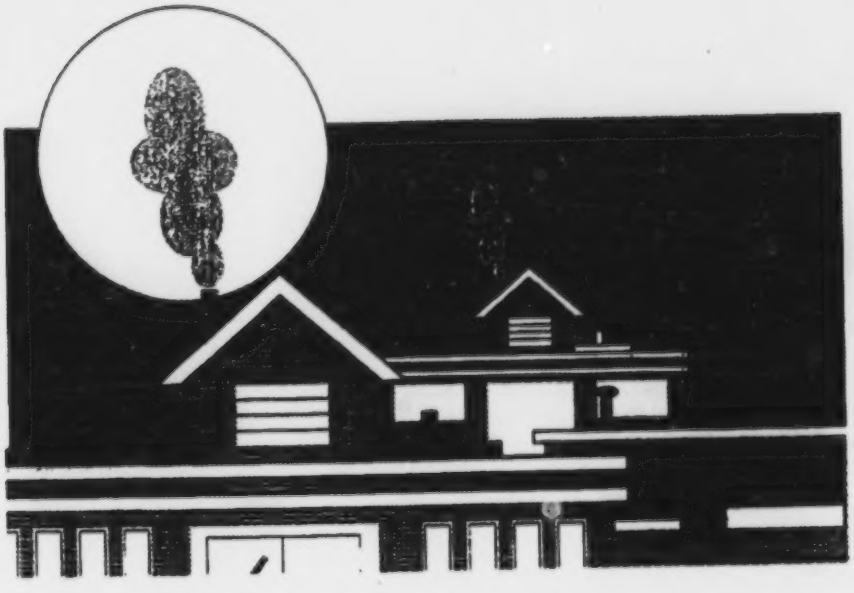

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FOREWORD

The statistics are frightening:

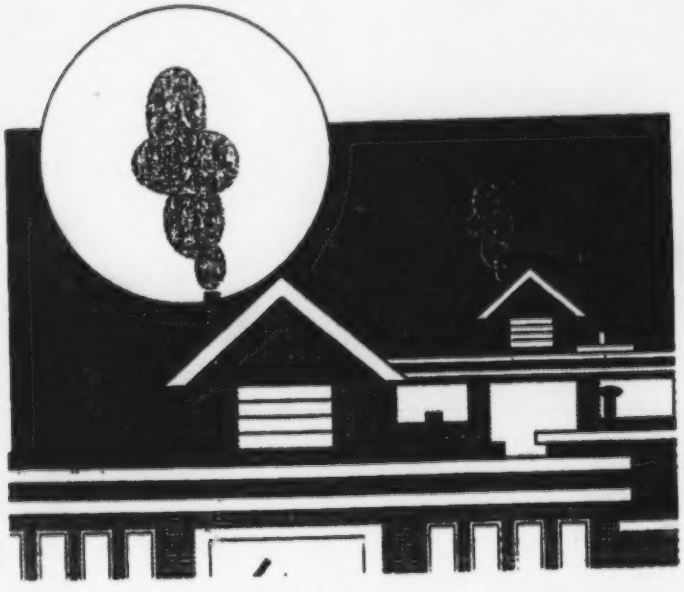
- $112 billion is needed to bring U.S. schools up to good overall condition.
- $11 billion is needed between 1995 and 1997 to comply with federal mandates.
- 14 million students attend schools in need of extensive repair or remodeling.

Clearly school building maintenance and operations can no longer be a back burner issue, left unattended while more glamorous projects are addressed. School districts must begin devoting more resources to ensure that their students attend classes in an environment conducive to learning.

To help school business administrators address the multitude of maintenance and operations challenges they are facing, the editors of School Business Affairs, the monthly magazine of the Association of School Business Officials International, have compiled the best maintenance and operations articles that have appeared in the magazine in recent years. The collection ranges from an overview of maintenance program management to specific maintenance projects such as recycling and pesticide use.

It is ASBO's hope that bringing these articles together in one place will provide students and practitioners with a valuable, easy-to-use resource that will contribute to the enhancement of school facilities everywhere.

Maintenance and Operations Management



Planned Maintenance Programs

Staying Ahead of Trouble

◆ By Dr. Francis G. Cary

Preventive and predictive maintenance will help your school district avoid costs and increase productivity. The mission of the maintenance program is to support student learning by keeping schools in good repair in a cost-effective manner. Facilities are becoming highly automated, and technically complex, yet maintenance program budgets are often reduced. It is apparent that old maintenance concepts — fix it when it breaks — cannot meet the current expectations for school facilities. A preventive maintenance program coupled with a planned replacement program is a must.

The Planned Maintenance Program

Planned maintenance is not a new concept. Used in manufacturing facilities for many years, the movement to a proactive maintenance model has recently appeared in the public school sector. As our workforce becomes smaller while costs continue to escalate, the maintenance department must operate in the most efficient and effective manner possible. No longer can the maintenance manager wait for something to break before it is scheduled to be fixed. Although some breakdowns will continue to be unforeseeable, today's manager has an abundance of skills and tools to predict and prevent likely breakdowns.

Planned maintenance is a mind set. It is a program in which the wear and tear on the school and its equipment are monitored and corrected before a breakdown can occur. A key part of the program is recognizing which units and major components should be monitored. All items should not be included. In economic terms, lower costs will result from performing tasks in a controlled and planned atmosphere. A planned program allows the maintenance manager to use resources most effectively and to avoid the stress and inefficiency of panic maintenance.

Buildings, building components, and equipment all require various levels of continuous maintenance to achieve or extend their expected useful life. Planned maintenance may be viewed on a continuum encompassing:

- Preventive maintenance;
- Routine repairs;
- Major component replacement;
- Renovation; and
- Modernization.

Preventive Maintenance

Preventive maintenance is provided to ensure that building components or equipment will achieve or exceed their expected useful life. It begins when the item is new and continues until it is replaced or modernized. Preventive maintenance is a program in which the wear, tear and change are anticipated and corrected to obtain optimum efficiency and to reduce the deterioration. The tasks are performed on a planned schedule based on manufacturer or trade recommendations, the type and amount of use an item receives, and the degree to which the item is critical to the operation of the building.

Preventive maintenance includes lubricating, checking for proper operation, adjusting and aligning, and identifying items to be repaired or modified. A roof, for example, requires that pitch pockets be checked and filled with asphalt, windswept slag areas be recovered, roof drains opened, debris removed and rooftop equipment leaks repaired.

Routine Repairs

Despite the best preventive maintenance, as items get older breakdowns necessitating repairs

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will occur. The routine repair program restores an item or component to its normal operating/useful condition. Inexpensive items, such as door hinges or small electric motors, are replaced or repaired at breakdown rather than performing frequent preventive maintenance activities.

Major Component Replacement or Renewal

The objective of the major maintenance program is to completely overhaul or replace a worn-out building component. Looking at the standard components of a building — heating, cooling, ventilating, roofing, flooring — reveals various life expectancies. In most cases, the components begin to wear out the moment they are placed in service. Their serviceable life is influenced by the quality of the original component, amount of use, and the quality and quantity of the maintenance effort. Major maintenance for an item or component is undertaken when:

- The repair costs are higher than the unit replacement costs;
- Unit reliability dictates replacement;
- Replacement units offer lower operating costs; or
- Existing components can no longer meet changed needs and requirements.

The major maintenance effort provides a program of planned life-cycle asset replacement (PLAR). It is beneficial and often necessary to replace building components that do not last until the facility is modernized. Replacing major components (roofs, heating, cooling, plumbing, mechanical partitions, flooring, communication systems) prevents deterioration of other components, reduces routine maintenance requirements, and maintains a comfortable and functional learning environment.

Based on surveys of school staff, maintenance technicians, manufacturer recommendations, and non-destructive testing, a comprehensive, multi-year, school-by-school plan is developed for each fiscal year. The funding, normally a capital expenditure, renews the useful life of the building and avoids costly break-down repairs. It targets what many school districts and organizations have labeled "deferred maintenance."

Renovation

The objective of the renovation program is to make minor modifications to the existing space or components to allow the educational activities to operate effectivity and efficiently. Examples of renovations include dividing a classroom into smaller spaces; creating a computer laboratory; providing building access for handicapped persons; modifying a building with an energy management system; or installing electronic light ballasts.

This component of the planned facility maintenance program is an integral and necessary part of the overall activities. It is not maintenance in the sense of repairing or replacing components; it involves minor changes to the physical plant to meet the educational requirements of the individual school prior to the planned major modernization of the facility.

Modernization

Modernization activities bring the facility up to current building, life-safety, handicapped, energy, and education codes and standards. It replaces all remaining building components not previously renovated or replaced through PLAR or major maintenance. A comprehensive survey is conducted by engineering, architectural and educational staff to determine the scope of the modernization. The outcome of the modernization program ensures that the school will be functional and useful to support educational activities for the next 25-30 years.

Establishing a Planned Maintenance Program

Each building, building component, and piece of equipment has a life-cycle of maintenance activity. From the time of its initial construction or manufacture until it is replaced, there are known maintenance activities that should be performed if it is to achieve its expected useful life. Some maintenance activities will extend the life of the asset. A boiler, for example, must be periodically inspected, lubricated, cleaned, and it must have its flame adjusted. At scheduled intervals in its life-cycle, planned maintenance will include boiler tube replacement, burner replacement, and possible conversion to a more efficient or less costly fuel. The frequency of these tasks may be based on a time interval, on the amount of usage, or service records.

Step 1 — Establish a Planned Maintenance Policy

The concept of planned maintenance must have the commitment of everyone — the board of education, the superintendent, administrators, principals, educational staff, and maintenance and operations personnel. It must be understood and fully supported from the top management through the work force. If individuals performing the work do not understand and believe in the program, it will be less than successful.

Selecting items or components to be included in a planned maintenance program is first an economic question, then a question of the items' critical value to the operation of the building. Will failure endanger the health and safety of staff and students? Will the breakdown cause a failure in another component? Is standby equipment available? How high is the investment in the item or component? Can replacements be easily obtained and made?

Policy decisions should be made to guide the development of the planned maintenance program. It must be decided what level of maintenance effort the district can afford and is willing to undertake. The level of planned maintenance varies from no planned maintenance for an item or component to a planned maintenance program that provides for no breakdowns of the unit or component.

Break-and-Fix-it Maintenance. This strategy is for inexpensive, noncritical items or components. Nothing is done until it breaks or a repair request is made. Examples might include a hinge on a noncritical door; exterior signs; floor tile; light switches.

Minor Repairs. Planned minor service or repair on an item can be

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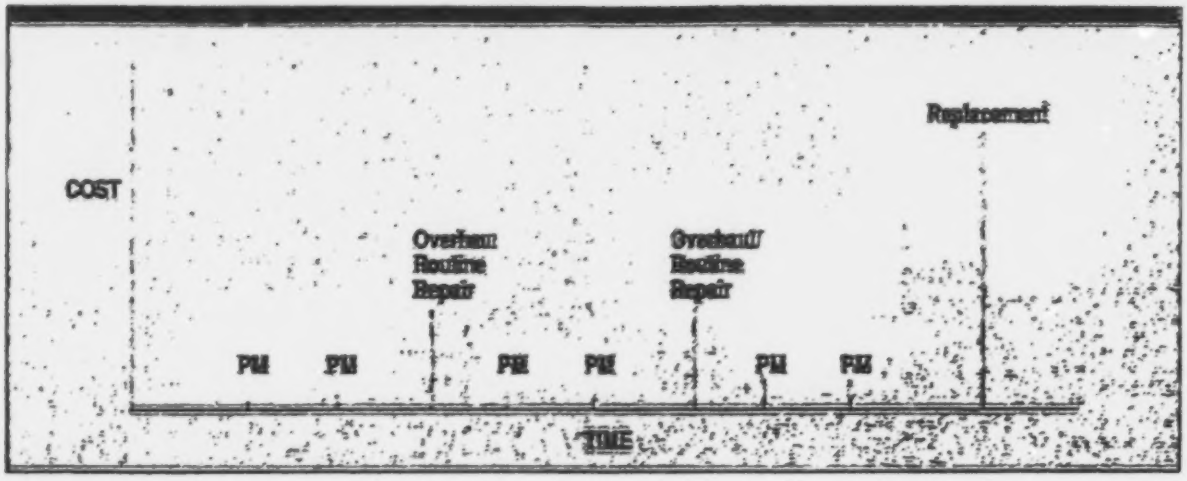

FIGURE 1
Sample Equipment Maintenance Effort

scheduled as a part of the ongoing preventive maintenance effort. Frequently, it includes lubrication, adjustments, part replacements and minor refurbishing.

Planned Maintenance for No Failures. This level emphasizes an aggressive preventive maintenance program including major overhaul and replacement of critical components identified through nondestructive testing and analysis. Through close monitoring, analysis, and predictions, the component is maintained to avoid any downtime. Examples of this type of maintenance include air conditioning for a mainframe computer facility; or emergency power generators.

Step 2 — Identify the Components for Planned Maintenance

Once the policy and levels of planned maintenance have been developed, the items or components to receive the maintenance are located and identified within each facility. For equipment items, it may mean attaching an identification tag or number; for non-equipment items, it may mean establishing appropriate location identifiers or descriptors to be included in a data base.

Step 3 — Establish Planned Maintenance Tasks

A list of maintenance work to be accomplished for each item or component must be developed for the maintenance mechanic or contractor. The tasks should be related to the importance of the item and incremental in nature to avoid initially overburdening available resources. The tasks can be listed in the form of a blanket work order which identifies needed tools and recommended materials for the job.

Step 4 — Determine Frequency

For each planned maintenance task, determine the frequency of performing the work. The interval may be based on time (daily, weekly, annually), usage (every 100 hours of operation) or on testing information (vibration analysis, oil analysis, visual inspections). Criteria for determining the frequency of the planned maintenance activity should always include a comparison of the planned maintenance cost and the breakdown/replacement cost.

Step 5 — Implementation and Monitoring

Assignment of resources to accomplish the planned maintenance program may require major adjustments in schedules and thinking. The workforce, contractors, and administration must be informed and committed to the program. Record keeping, parts inventory, and training programs must be in place and effectively operating to make the program successful. The planned maintenance program should be implemented in phases to ensure success.

Once the planned maintenance program has started, periodic inspections and monitoring of the effort are to be made. The planned maintenance program is to be analyzed, revised and expanded. Dynamic in nature, the full effects of the program in savings will not be realized for 12 to 18 months after implementation.

Step 6 — Data Analysis

Documentation, analysis, and information generated from the program provide the maintenance manager with failures, breakdowns, and associated costs. The analysis can identify mean times between failures and the life expectancy of components. Based on the analysis, the frequencies of the planned tasks or the specific tasks may be changed. Financial records for the program should identify the planned maintenance costs and the effect on the total costs of maintaining each facility.

Cost data should be used to evaluate the effectiveness of each maintenance effort. A typical maintenance effort for an equipment component is depicted in Figure 1.

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Suppose, for example, each preventive maintenance task for a component costs $320; the routine repair task costs $470; while the unit replacement cost is $4,000. Once this financial data is collected, the manager can make decisions concerning the impact of the planned maintenance program; if the PM task is changed, how will it impact the cost of the overhaul/repair task? What happens when the frequency of PM is reduced? What is the impact on the life-cycle costs if the minor maintenance tasks are eliminated? Should the replacement be planned earlier/later? What is the impact on breakdowns?

Implement the Program with Caution

- Phase the implementation of a planned maintenance program. Begin with the most critical components and expand the program to include additional items.
- During the initial phases of the program, the demand for resources (labor and material) will be high. It is difficult to assign resources to the planned maintenance program while taking care of breakdowns.
- Everything is not to be placed in the planned maintenance program. It is unrealistic to expect total preventive maintenance for all building components.
- Mechanics and accountants do not like to repair something that is not broken or to replace a component that has not failed.
- Assign the responsibility of the planned maintenance program to your most skilled planners and craftsmen.

In summary, because of the large investment in complex schools and the high expectation for a quality learning environment, facilities must be maintained in peak operating condition at optimum costs. A planned maintenance program offers alternatives to the breakdown approach or using a component until it fails. The cost of scheduled repairs is significantly less than the costs resulting from major breakdowns. With a comprehensive program, breakdowns and unexpected failures will be reduced or eliminated. Regardless of the budget or square footage, a planned well-managed maintenance program can be cost-beneficial to the school district.□

Dr. Francis G. Cary is Director, Division of Maintenance, Montgomery County Public Schools, Rockville, MD.

Custodian Quota Quandary Cured
Guidelines for Custodial Staffing

By Robert A. Getz

Have you ever been asked to justify the size of your staff? Has anyone ever asked why there are eight custodians assigned to the administration building and only five to their school? Is there any logic to the 5 or 10 percent cutbacks you've been required to absorb during the past five years? Where do you turn for help?

In the past, guidelines for determining custodial staffing levels have never been developed because, it was assumed, every facility was unique. Each was different in terms of traffic density, frequency of use, age, locations of custodial space and so forth.

However, starting in the fall of 1986, a group of college and university physical plant directors and others began to challenge this assumption. Seven national/international associations and more than 250 colleges, universities, government agencies and private businesses began sharing ideas. After five years of research, custodial staffing guidelines were developed to determine the proper custodial staffing of facilities including ways to tailor the staffing for specific or unique circumstances.

Although currently limited to office, classroom and laboratory facilities and their ancillary areas of entranceways, public areas, storerooms, stairwells, restrooms and locker/changing rooms, the guidelines will be expanded. Plans are also being developed to include landscape and maintenance work forces. Eventually, a total staffing directory for all work forces supporting facilities will be compiled.

Levels of Cleanliness

The first step in developing the custodial staffing guidelines was to establish the levels of cleanliness desired in custodial operations. Research led to five such levels:

Level One: Orderly Spotlessness—This is cleaning at the highest level. It was developed for the corporate office suite, the

FIGURE 1
Factors for Determining Custodial Staffing Levels

CATEGORIES	
Facilities	Ancillary Areas
Office	Entranceways
Classroom	Public Areas
Laboratory facilities	Storerooms
	Stairwells
	Restrooms
	Locker/Changing rooms

BASE TIME

Time needed to mop 1,200 square feet

ADJUSTED TIMES

Base time for a task x frequency (times per week) at the appropriate cleanliness level

CLEANING SQUARE FEET PER CUSTODIAN

420 productive minutes per day / adjusted time = office areas per day x 1,200 cleaning square feet per office

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FIGURE 2
Staffing Service Levels

TASK	FREQUENCY ADJUSTED TIME Level 1	Level 2	Level 3	Level 4	Level 5	Base Time
Vacuum carpet and straighten furniture	D 21.07	A/D 10.54	W 4.21	W 4.21	W 4.21	21.07
Spot-clean carpets	D 10.59	W 2.12	M 0.51	Q 0.17	Q 0.17	10.59
Relamp	D/A 0.09	D/A 0.09	D/A 0.09	D/A 0.09	D/A 0.09	3.91
Empty waste containers	D 6.60	D 6.60	D 6.60	A/D 3.30	W 1.32	6.60
Spot clean walls, partitions and doors	A/D 2.97	W 1.19	M 0.29	Q 0.10		5.94
Clean telephones	D 4.17	W 0.83	M 0.20	Q 0.07		4.17
Empty and clean ashtrays	D 0.73	D 0.73	D 0.73	A/D 0.37		0.73
Dust furniture and flat surfaces	A/D 1.44	W 0.58	M 0.14	Q 0.05		2.88
Clean trash containers	M 0.64	M 0.64	Q 0.21	S/A 0.11		13.35
Dust vents	M 0.09	M 0.09	Q 0.03	S/A 0.02		1.93
Dust blinds	Q 0.06	Q 0.06	S/A 0.03	S/A 0.03		3.60
Perform interim carpet care	Q 8.89	Q 8.89	Q 8.89			43.25
Project clean upholstered furniture	Q 2.12	Q 2.12	S/A 1.06	A 0.53		132.30
Clean windows	Q 0.19	S/A 0.10	S/A 0.10	A 0.05		12.06
Project clean light fixtures	S/A 0.91	S/A 0.91	A 0.45			113.50
Perform restorative carpet care	A 0.39	A 0.39	A 0.39	A 0.39		98.73
Adjusted minutes	52.75	27.68	15.73	9.49	5.79	
Cleaning Square Feet Per Custodian	9,555.00	18,208.00	32,041.00	53,109.00	87,047.00	

Frequency Codes/Daily Adjustment Factor

D—Daily/1.00
A/D—Alternate days/0.50
W—Weekly/0.02
M—Monthly/0.048
Q—Quarterly/0.016
S/A—Semiannually/0.008
A—Annually/0.004
D/A—Daily adjusted*

* Adjusted minutes are for 1,200 CSF.
Square feet per custodian based on 420 productive minutes per day.

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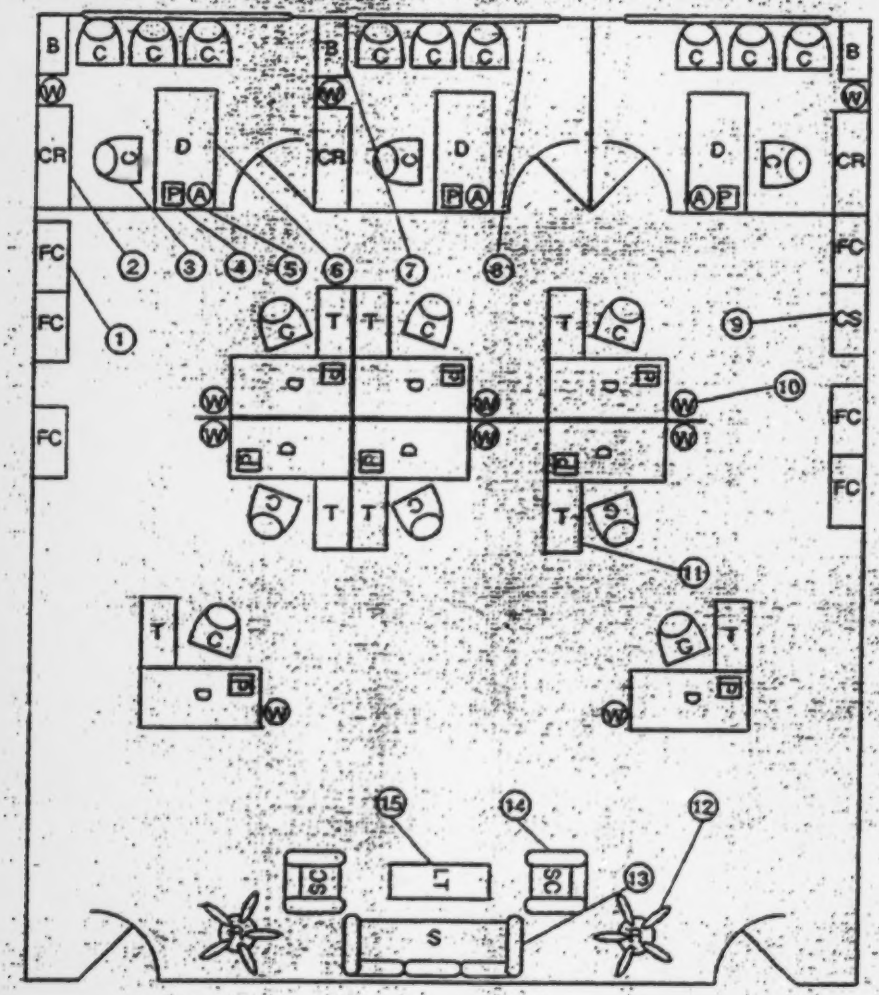
FIGURE 3
The Standard Office



Construction

30' x 40' (1,200 SF)
Carpeted floor
Gypsum walls, light semi-gloss paint
Drop ceiling, exposed grid
36 recessed two-tube 1' x 4' flourescent fixtures
45 LF x 4' high upholstered partitions
5 ceiling supply air vents
5 solid core wood entrance doors with louvered vents

Features

1. 6 sets of three-tier lateral file cabinets
2. 3 credenzas
3. 20 desks/sidechairs
4. 11 telephones
5. 3 ashtrays
6. 11 desks
7. 3 two-tier bookcases
8. 3 5' x 3' windows with venetian blinds
9. Table for coffee service
10. 11 wastebaskets
11. 8 typing tables
12. 2 plastic rubber plants
13. Sofa
14. 2 upholstered lounge chairs
15. Low table

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donated building or the historical landmark.

Level Two: Ordinary Tidiness—This is the practical base upon which the guidelines were established and the level at which cleaning should be maintained. Lower levels for individual facilities such as restrooms or locker/changing rooms are not acceptable.

Level Three: Casual Inattention—This level reflects the results of initial budget cuts and is a lowering of normal expectations. While not totally acceptable, it is a level of cleanliness that has yet to reach what one would consider "unacceptable."

Level Four: Moderate Dinginess—This would reflect a further stage of budget cuts. At this level, some areas within a facility would now start to become unacceptable. Building users would begin to accept an environment lacking normal cleanliness. The facility would begin to look like it always required a good "spring cleaning."

Level Five: Unkempt Neglect—This is the final and lowest level and could also be called "just-in-time cleaning." At this level, the facility is always dirty, with cleaning accomplished at the point of unacceptability.

These levels of cleanliness have been summarized into a staff level summary (or executive matrix) for staffing. The individual matrices for each category have been condensed to show a total cleaning-square-footage-per-custodian at each level. For example, for an office area maintained at level two each custodian would be expected to be responsible for 18,000 cleaning square feet.

For a quick, rough, thumbnail sketch of how many custodians are required to staff a particular facility, you need only measure the total square footage to be cleaned and divide it by the number in the staffing level summary. For example, an office complex containing 36,000 square feet of space divided by 18,000 cleaning square feet per employee would require two custodians at level two. The guidelines break down custodial activity into a unique matrix for each individual category, e.g. bathrooms, to provide more detail on staffing levels.

Task Times Compiled

Based on surveys of participating institutions a "base time" per custodian has been developed for every cleaning activity likely to occur in each of the categories (see Figure 1 for a list of the categories). For each category, a staffing service level chart has been created from the base times (Figure 2). Each task for a category has a clearly defined time and frequency at each level of cleanliness. In general, as the cleanliness levels change from one through five (cleanest to dirtiest), frequencies and adjusted times for any given task tend to decrease. Depending upon the area to be cleaned, certain tasks may be eliminated altogether at the lower cleanliness levels.

Those times have been adjusted and totaled to enable the manager to calculate the cleaning staff required on the as-

FIGURE 4
Customizing the Custodial Guidelines

EXAMPLE #1

During the course of the study, the changing of lights was assumed to be a normal part of a custodian's responsibilities. Suppose that is not the case at your location. Simply delete that task and subtract that time from the total. Then, adjust the numbers and a unique Cleaning Square Footage per Custodian for your facility is the result:

27.68	Adjusted minutes per day as shown in the guidelines for an office area at Level Two.
-.09	Minutes per day for relamping.
27.59	Minutes per day for your unique time.

The custodian's 420 productive minutes per day are then divided by this unique adjusted time which totals 15.2 office areas per day. These 15.2 office areas per day are then multiplied by 1,200 cleaning square feet per office area totaling 18,240 cleaning square feet per custodian. The result is a slightly higher base for your facility than the 18,208 cleaning square feet shown as the base for custodians in office areas at Level Two in the guideline's matrix.

EXAMPLE #2

Recycling is a new item on everyone's agenda. It was not, however, included in the computations for cleaning an office area. If a time has yet to be determined by your staff and the custodians are required to collect and keep recycled paper separate, recycling may be treated as a second waste paper collection and simply added to the totals.

27.68	Adjusted minutes per day as shown in the guidelines for an office area at Level Two.
+6.60	Minutes per day for second paper collection/recycling.
34.28	Minutes per day for your unique time to allow recycling.

As in the previous example, the custodian's 420 productive minutes per day are divided by the unique adjusted time of 34.28 leaving a total of 12.3 office areas per day. Those 12.3 office areas per day are then multiplied by 1,200 cleaning square feet per office area totaling 14,760 cleaning square feet per custodian. Note that, as a task is added, a custodian's expected coverage declines—in this instance, the decline in coverage went from 18,208 cleaning square feet as shown in the guidelines for Level Two to 14,760 for your facility to allow sufficient time for your custodians to add recycling to their responsibilities.

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sumption that a full-time custodian works a 420-productive-minute day. Using an office for an example, the base times assume an area of 1,200 square feet (Figure 3). Variables may then be added or subtracted to customize the guidelines to a particular building or area (Figure 4).

Figuring In Benefits

Since every locale computes leave benefits differently, i.e., sick time, vacation and other time-off allowances, it was not included as part of this study. That factor may, however, be calculated easily after your staffing level is computed by multiplying the benefit factor by the total staffing.

Suppose, for example, that you have a 15 percent benefit package and have determined from the formulas outlined above that you require 20 custodians for your combination of cleaning levels, tasks and categories. Multiply those 20 custodians by the .15 benefit factor for a total of 3 custodians; this will be the number of substitutes which will be required to replace custodians on leave.

An All-Purpose Tool

The guidelines may be used to determine staffing levels or documents for contracting. They may also be used to brief building occupants or to set work requirements for individual custodians. In addition, they contain an audit device to allow a determination of whether or not the current staff is meeting expectations based on the number of custodians within the work force.

Conclusion

Six years in development, these custodial guidelines were long overdue. They are now, however, being utilized across the United States in a variety of circumstances. A major university used the guidelines in preparing presentations to explain the effects of budget cutbacks. A large city school district used the guidelines to win a grievance over an employee's work assignment. A college in the Midwest redesigned each of its workers' assignments following the guidelines. Those assignments were used as bid documents for the work force. Another school district used the guidelines in conjunction with the worker's union representatives to establish more realistic job assignments.

The research is continuing into more detailed analyses of specific spaces and will eventually be expanded to include other work forces. The first expansion of the study is expected to be landscaping and grounds followed by maintenance and HVAC work forces. The guidelines will eventually embrace the entire facilities work force.❑

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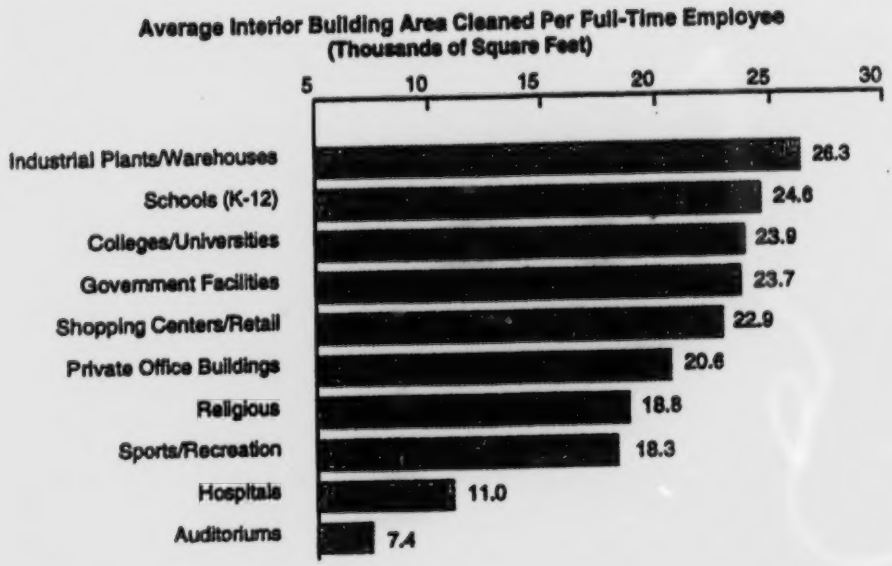
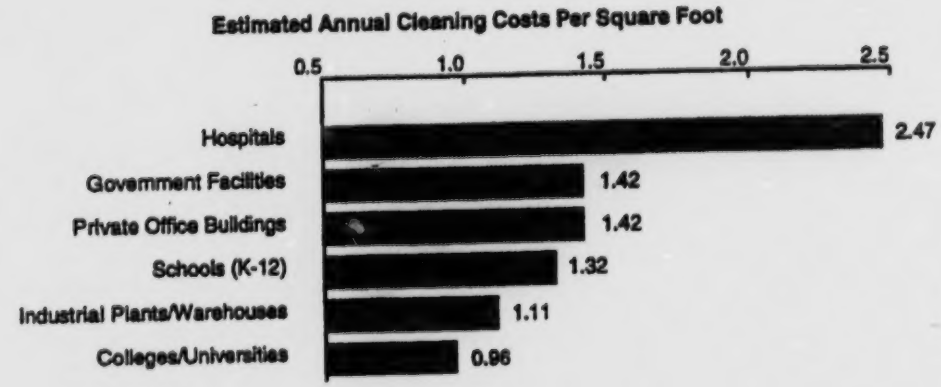
Editor's Note: The guidelines were published by The Association of Higher Education Facilities Officers in April 1992. The publication is entitled Custodial Staffing Guidelines for Educational Facilities *and is available through: Steve Glazner, Director of Communications, The Association of Higher Education Facilities Officers, 1446 Duke St., Alexandria, VA 22314-3592, 703/684-1446.*

K-12 Cleaning Crews



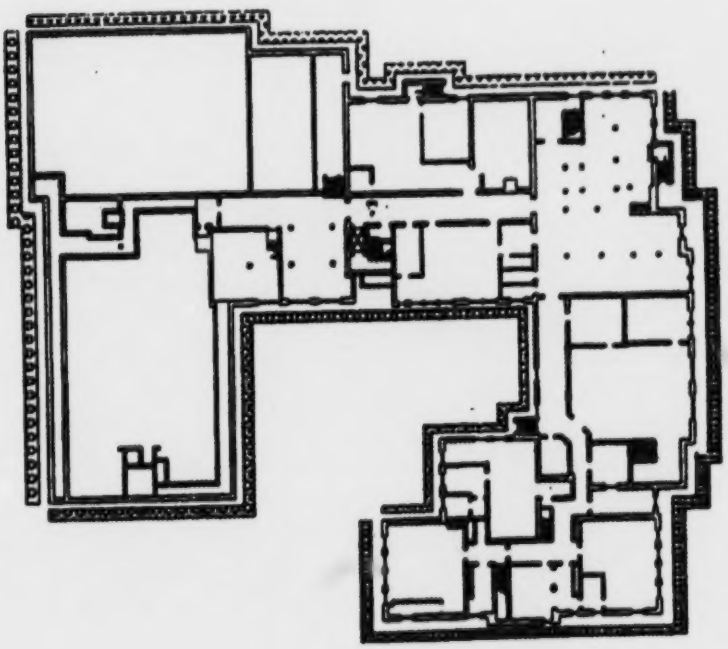


Cleaning crews for K-12 schools stacked up well against those in other types of facilities, according to the *1994 In-House Survey* conducted by the Cleaning Management Institute for Cleaning Magazine. The annual cost per square foot to clean schools was just $1.32, while the average full-time school employee could clean 24,600 square feet per day.

From Bad to CAD

Maintaining Records of Maintenance Projects

By Diane C. Shea



Do the records of maintenance projects for your school district reside only in the memory of the director of maintenance or, at best, in outdated filing systems? When information is needed on a particular project, do you have to manually search through old purchase orders?

This was the situation at the Farmington Public Schools (CT). Our manual record-keeping system was very time consuming and, if the project in question occurred many years ago, information was sometimes impossible to find. To compound the problem, once the data was uncovered, there was no organized way to record that information for use at a later date. We often duplicated work in response to questions asked at different periods of time about the same project.

We recognized that relying on the recall of one person and a cumbersome paper filing system to provide valuable information over time on maintenance projects was a troublesome weakness in our record-keeping system. The next step was to determine how to rectify this situation in a way that would provide information on maintenance projects by school and category of project over time.

A review of existing maintenance record-keeping methods provided insight into a variety of systems. We looked at a range of systems from computerized data entry systems that allowed sorting of specific information by location to hand-posted "index card" systems that provided a historic listing of information.

These systems often required individual research and separate report writing to use information. And most systems lacked an important component—flexibility. These record systems were more than what currently existed in Farmington, but the ability to obtain data in an "easy to access" format was not apparent in our review of available data collection systems for maintenance.

We wanted more from these record-keeping maintenance systems. We wanted them to make it easy to access information and make it easy to input data. We wanted them to allow us to upgrade the school building configurations to today's school plants. Finally, we wanted them to be flexible enough to allow expansion and growth of the system. Plans to purchase

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and implement a computerized maintenance system were delayed until we could find something that met our needs.

Discovering CAD

During the renovation of East Farms Elementary School, our architect forwarded a computerized building plan (herein referred to as a "foot-print") for use in bidding carpeting. This computerized plan was produced by a computer-assisted design (CAD) software program.

Located on the "foot-print" were various symbols indicating what color carpet was to be installed in each area of the school. A "tight" dot pattern indicated Plum Heath carpet while a "wave" dot symbol indicated Monet carpet and a "spaced" dot meant Highland carpet. Anyone could view this one-page building plan and immediately understand the color scheme for carpet and where each color was to be installed.

The old saying holds true, "A picture is worth a thousand words." Here was what we were looking for—a computerized graphic system that could be used as a record-keeping system for our maintenance projects.

CAD software has a phenomenal advantage over hand-prepared architectural drawings. To fully understand the flexibility of this software, we reviewed how CAD software was used. Learning about the architect's use of CAD to design the renovation plans for East Farms Elementary School provided us with insight into its power and flexibility. A discussion of CAD functions with the high school technology teacher further heightened our awareness of the complexity, as well as potential, of this program.

Investigating its Applicability

Comprehending the potential of CAD and its possible use as a record-keeping system for maintenance projects raised many questions:

- Can anyone be trained to use CAD?
- How do you enter data into the system?
- How is this data accessed and turned into usable information?
- Does it require a specific computer, and, if so, what type of computer and printer is necessary to run this application?
- Is CAD applicable to maintain project records on maintenance of buildings?
- How do you load existing building blueprints into the computer's memory?
- How much will it cost to implement this system?

We faced many perplexing questions, but the vision of using CAD for recording all our maintenance projects was too tantalizing not to be pursued.

The first task necessary to move this concept forward was a review of our existing computer equipment to determine if it was capable of running CAD software. Recommended computer equipment requirements to use CAD include a 486 PC with math co-processor, a minimum of 8 megabytes RAM, and at least a 40 megabyte hard drive. A video display monitor with graphics board and a printer plotter to produce full-size sheet drawings are also required.

"We faced many perplexing questions, but the vision of using CAD for recording all our maintenance projects was too tantalizing not to be pursued."

Next, a review of the CAD software in our high school technologies department found the version to be too old for use with this sophisticated project. Therefore, we upgraded the license held by the high school to a newer and more powerful version of the program and transferred it to the school business office.

Loading Existing Blueprints

CAD is a program used by architects to create new buildings or renovate existing buildings. It is efficient but requires the expertise of a trained person to use its numerous commands and functions. Farmington was not creating new drawings. Our requirement was to take the existing blueprints of our schools and transfer them into a CAD system in order to create an information foundation for maintenance project records.

Transferring our existing blueprints onto computer disks was accomplished by electronic scanning. We contracted with a local vendor to handle this.

Another method used to convert existing school plans to computer disk is to re-draw the buildings using available blueprints. This is a labor intensive technique, but it may be the only available alternative if scanning is not feasible.

When would scanning not be feasible? Many school blueprints have been reproduced on blueprint paper using blue ink from an architect's original "tracings." In addition, these drawings contain too much detail for the purpose of a maintenance record-keeping project. In some cases, these old drawings are incapable of being scanned because they are not clear documents. Using CAD to redraw the basic foot-print, prepares the database for the next step in the process.

Once the school's basic foot-print plan has been converted to a computer file, the necessary fixtures (doors, windows, stairs, lavatories) are layered onto the system.

As the Farmington building plans were being scanned in, it became clear that the "output" was only as accurate as the blueprints used to provide the "input" of information. In other words, we were looking at building plans that in many cases were over 25 years old and no longer accurate. Minor renovations of our schools (addition or removal of walls and doors, or

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relocation of classrooms) were not re-drawn on existing floor plans. An analysis of our computer-generated floor plans alerted us to the immediate need to update these foot-prints to reflect our current building structures.

To accomplish this task, a high school student (normally hired as a summer custodial worker) was hired to audit the computer-generated plans and modify each building to its current status. Getting our building plans to "as built" documents was one of the most beneficial tasks accomplished in this project.

Our high school student excelled in CAD software, and we used his expertise not only to audit the buildings, but also to load all corrected information into our computer system. By the end of the summer of 1991, Farmington had six schools to "as built" format on CAD.

Can Anyone Be Trained To Use CAD?

The issue of training staff became the most difficult obstacle to overcome. The director of maintenance would be the person using this system and, therefore, we decided to train him. One week of intense training resulted in a disappointing phone call from the CAD trainer stating that our director of maintenance had the willingness to learn but the program was too complex for him to stop his training now and begin using it at a later date.

It was not easy to face the possibility of having to abandon the entire concept because of the learning curve inherent in a complex computer program. Remember, one major criteria for our new maintenance system was ease of operation and use. Unfortunately, using powerful and complex software such as CAD requires a person with background and training in this application.

Research on how to move forward created several viable options:

- Hire an exceptional CAD student at the high school (or college) and pay him/her to load the maintenance project data into the computer system;
- Contract with an architectural firm to load the data;
- Hire a consultant who is trained in CAD to provide the needed expertise; or
- Research a way to link the CAD software with a simpler data entry software package.

"Unfortunately, using powerful and complex software such as CAD requires a person with background and training in this application."

Farmington had used CAD as the foundation for formatting the building foot-print and had layered onto the system required windows, doors, fixtures, stair well locations and square footage data. Using the layering system inherent in the CAD software (drawing each category of information in template format onto the foot-print) requires a highly trained individual. If we could use the CAD foot-print and link the maintenance project history information through a simpler "user friendly" data input method, the problem of requiring an expert to input the project history information would be eliminated.

A company called Softdesk offered the solution of moving out of the "layering of information" required by CAD to the environment of database/query which enables the user to link graphical and non-graphical entities on drawings. Now we were in the very familiar environment of database entry that is used in many school finance computer systems.

An investigation into this software application renewed our hope. If this software could be used to enter project information and the software would automatically link information to the proper area on the building foot-print, the vision of having a user-friendly, flexible system was possible.

Up and Running

Farmington Public Schools successfully installed Softdesk onto the CAD computer system and currently enters and links maintenance project information as follows:

- Location of all fire extinguishers and emergency exits including when fire extinguishers must be retested;
- Type of floor covering—carpeting or tile, including color, manufacturer and year of installation;
- Paint colors of classrooms including the type of paint and the year the room was painted;
- Room numbers and use of each room by the school;
- Square footage of each classroom and other areas in the school buildings;
- Roof information including type of roof, company used to install it and the year it was completed;
- Ceiling tiles and lighting.

This list represents the beginning of a lengthy process necessary to input specific maintenance information for each school into the CAD system. Since this is a very powerful system the only limit is imagination.

Information on maintenance projects is portable and easy to understand because it is presented on the "foot-print" of each school building. In addition, Softdesk (with a report generator program added) allows the visual information to be converted to report format. An example of one report used extensively in Farmington is the painting schedule of each classroom by building. Included in the report is the color, type of paint, date the room was painted and the brand of paint used.

This type of data-based report provides important planning information for the maintenance

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department. A system of classroom painting has been established that allows uniform color selection and assures that each room will be maintained through a uniform repainting schedule.

The process of determining what is to be included in the system started with recording major maintenance projects (i.e. roofs, flooring, windows, window coverings, bathroom partitions, etc.) and has expanded to encompass fire and safety information, asbestos locations, air handling units, communications systems and exhaust systems. Our computerized maintenance system provides visual as well as data-based reports of maintenance projects and continues to extend into other task areas that will be mentioned later in this article.

Other uses for this information became apparent when the director of maintenance used the system to highlight maintenance projects for the upcoming budget. If the project was to be completed in phases, the system showed what had been completed, what was being requested in the next phase of the project and how many phases remained to complete the project. All of this information fit on an 8½" x 11" piece of paper.

Communication from the schools on current projects and entering information into the system has been accomplished by redesigning our work order report. By adding a few necessary data fields to the work order form, a vital communication link is in place for entering current project information. Similar to adding a purchase order into our accounting system, the work order information is entered and automatically linked to the CAD foot-print.

A Valuable Addition

Time is a scarce commodity for school business administrators. If a maintenance director has to spend an inordinate amount of time researching a project's history and does not have an adequate recording system to keep track of this research, work often has to be repeated. Repetitive information research costs money. In addition, accuracy of information (based on interpretation from the person utilizing it) can vary from project to project.

A uniform, easy-to-access information system where all important projects are uniformly stored and easily retrievable allows the user to see the same information in a consistent format. It eliminates interpretation of the data because the foot-print clearly indicates:

- Where the project occurred;
- Date of the project;
- Vendor who completed the project;
- Cost of the project;
- Color and material used (where applicable); and
- Type of product used.

Adding information on any project is accomplished by simply adding the desired component to the database and loading the appropriate information.

The accurate building foot-prints (including room dimensions and location of doors, windows, stairs and lavatories) proved useful in several other areas of school operation. From bidding of projects, to redesign of space, to a review of custodial cleaning assignments, to recording asbestos in buildings, the list of uses of our CAD maintenance system continues to grow.

As mentioned earlier, the only limitation is your imagination. We continue to find new uses for this powerful and very flexible tool. CAD linked with a dBase software program (Softdesk) has proven to be a powerful, multi-dimensional computerized system for recording and maintaining our district's maintenance projects.❑

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Who Will Fix the Roof?
Site-Based Maintenance Programs

By Dr. Glen I. Earthman

Public schools have traditionally been associated with the concept of central administrative decision-making. This application originated for a variety of reasons but primarily from the need to have control over a large organization and to bring uniformity of application to an organization with many sites. This model has served the public schools well in the past by introducing and internalizing some efficient administrative practices into local organizations.

For the past decade, however, administrators have felt the need to have decision-making closer to the action. They see it as beneficial to the educational process to have decisions made as close to the student as possible with the anticipation that local resource disbursement will positively affect learning. Further, it is believed that local allocation of funds provides greater efficiency and allows for more flexibility in application of resources.

School site-based management is usually thought of as an alternative organizational arrangement from the usual hierarchial school system governance arrangement where decision-making power is lodged in the central administration. It is generally defined as a system where the individual school building is the focus of educational decision-making as contrasted with central administration. The responsibility for making these decisions is most often lodged either in the building principal, faculty, community members, or any combination of the three. In some cases, even students are involved in the decision-making process.

This kind of alternative organizational arrangement has been implemented in many school systems throughout the country. The exact arrangement, however, varies considerably from locality to locality depending upon how the local educators or school boards conceptualize site-based management or how state or local statute defines this organizational pattern. The variety of application extends from one extreme to the other. In some instances, site-based management is in name only, whereas in a single building organization such as a private school, site-based management is the only organizational pattern available.

Site-Based Administration

The hallmark of almost every site-based management application is the local authority over three aspects of administration: budget, curriculum, and personnel. At least these three functions have to be explained and operationalized in some form in any plan for decentralization of decision-making or devolution of power. Site-based budgeting assumes that local personnel are better informed as to the resource needs of students and can expend funds in a more efficient manner than through a central administrative office. In some of the more distinct applications of site-based budgeting, local school staffs are allowed to determine how a given lump sum of funds is distributed for personnel, equipment, supplies, and even maintenance.

Site-based curriculum development refers to decisions made regarding subject matter offered or methodological application. The belief here is that principals, teachers, and parents working together can produce the necessary results in students and meet their educational needs more accurately than can a director or supervisor from a central office.

Personnel decisions in site-based management schemes are made based upon the idea that the local school organization should choose what kind of staff will be working there if the school staff is to be held accountable for student performance.

Site-based management is considered a significant trend in American education today, which means that every school system in the country must deal with it in some fashion. A school system may choose to ignore the trend and continue in the present operation, whatever that may be. That is usually not what happens in practice, however.

There are those school systems,

that because of small size, have always utilized site-based management simply because that is the best and probably the only way to operate. The larger school systems, however, are the ones that must confront the issue. These school systems must decide whether site-based management, regardless of concept, will be put into practice. In some cases, state governments have mandated site-based management schemes.

Whatever the definition of site-based management in the local school system, the actual areas of responsibility and decision-making need to be negotiated. In other words, the central administration and the local school building administration needs to come to some agreement as to what decisions are to be made on the building level and what decisions are reserved for central administration. Of course, the actual focus of decision-making regarding the three areas of concern will vary in each jurisdiction, but this is the first step in implementing site-based management. State mandates will influence how much decision-making authority the local school building staff will have in matters involving the curriculum.

In addition, union contracts may affect the amount of decision-making authority the school building staff has. The amount of school building decision-making in budgetary matters will rest on the school board and their interpretation of state fiscal regulations.

All of this, however, needs to be taken into account in developing a site-based management system. Empowerment of the local school staff has to come about as a result of negotiations of areas of responsibility.

Implementation of site-based budgeting will entail many facets of administration because of the need for resources to maintain certain levels of program offerings, staff availability, and deployment across the school system. On the other hand, local school building staff may be given very little authority in expending funds on these matters, and yet on the other hand, some staffs may be given great latitude, subject to certain resource allocation formulae and given accounting procedures of the central administration.

Funding Maintenance Programs

An additional area of great concern in budgetary areas that is usually addressed in site-based schemes is that of funding the school system maintenance program that covers every school building owned and operated by the school board. Preserving the initial investment the community has in every local school building is a very important responsibility of the school board. This body is charged with keeping each building in as good a state of repair as when it first opened. This is a difficult task to complete at best, given the limited resources available to the school board.

To complete this task, people with expertise in the area of building maintenance are employed by the school board. These staff members are experts in keeping the school buildings in good working condition. Maintenance employees are usually deployed and directed by the central administration staff.

The centralization of the maintenance function of the school system has been seen as beneficial for several reasons. First of all, the limited resources available can be applied in a uniform manner to all of the needs of the school system's inventory of buildings. In other words, each school building is treated equally and fairly in regard to maintenance needs and resource availability.

In those school systems that have a centralized maintenance schedule, equal resources will be allocated and maintenance needs addressed for each building on a regularly scheduled basis. Unfortunately, in some school systems, a regularly scheduled maintenance plan that addresses these building needs in a systematic fashion is not in place. In these cases, maintenance needs may not be taken care of in an equal and fair manner but rather as need arises. As a result, not all maintenance needs may be addressed nor preventative maintenance measures implemented. For the most part, however, a centralized maintenance program can provide for an equalization of resource utilization and a uniformity of practice.

The second benefit of centralized maintenance is that it relieves the building administrator of the responsibility of completing the maintenance work that is always evident. Usually the principal is seen as a person expert in administering the school education program and personnel; those tasks usually take the full efforts of the administrator to accomplish.

The process of identifying maintenance needs and then doing those tasks required to get the work done, however, is generally perceived as being beyond the realm of responsibility of the building principal. To identify, schedule, and complete the maintenance needs, the school board employs experts and selected craftsmen who can handle these projects. This arrangement is a sort of divided administrative responsibility based upon expertise in the position.

Local School Building Involvement

There are, however, instances where the building principal and staff should have strong input into the time for scheduling the completion of certain maintenance projects. These situations are where the maintenance item has some impact upon the curricular program or the health and safety of the students and staff. In these cases, the building principal and staff should have a compelling voice into the decision when the project is to be completed.

Most school systems regularly, as a matter of policy, involve the principal, staff, and even community representatives in identification and scheduling of maintenance projects in the overall district-wide maintenance list. For the most part, such arrangements serve the needs of the school building staff by completing those projects they want to have done as well as accomplish the building maintenance needs as seen by the central staff.

Under site-based management schemes, however, decisions regarding maintenance needs might well become a negotiable item. This would mean that the extent

of decision-making of the principal and staff as far as maintenance projects to the building are concerned would be determined cooperatively with the central administration and eventually the school board.

Division of Responsibility Through Negotiations

The real question to be posed, however, is how much of the maintenance function should be the responsibility of the local school staff and how much that of the central administration. The maintenance function is much more than simply deciding which project, out of a list, to fund or not to fund, although that decision is quite important to getting the job done. There are at least six different processes involved in properly maintaining school property:

- Identification of the condition to be repaired, corrected, or maintained;
- Specifying or describing the method of repairing or correcting the condition and assigning a level of funding to complete the task;
- Scheduling the work to be done;
- Publicly bidding the project and awarding a contract to an outside contractor or assigning a school employee or team to complete the work;
- Inspecting and monitoring the work of either the outside contractor or school system employee;
- Certifying that the work was done satisfactorily and reporting back to the proper authority.

Some of these processes may not be within the desired range of purview of the school building staff in a site-based management scheme, but they all must be done by some office or person in the school system. Responsibility for completing these processes or tasks must be placed upon competent persons and must be aligned in such a manner as to assure proper continuity towards completion of each project. Deciding who or what office assumes these responsibilities then becomes the focal point in the division of labor between site-based management and central administration.

This is the point where the negotiations need to take place between the central administration and the school building administration and staff. Negotiations need to lead to the determination of responsibility for maintenance processes between either the central administration or the site-based management team. When negotiating these responsibilities, some very difficult questions need to be answered such as:

- How will maintenance funds be equitably allocated to individual school buildings: On what basis: per pupil, square feet, or building need?
- Will building principals and staff make the final determination of how maintenance funds will be expended?
- Who or what group will identify maintenance needs of the building?
- How will the school system achieve economy of scale/ volume in bidding projects; i.e., grouping like items for one bid; buying in bulk; obtaining similar services for more than one site.
- Who will be allowed to tender bids for maintenance projects?
- What maintenance projects will be bid by the building staff or by the maintenance department?
- How can the school board guarantee adherence to proper legal procedures when projects are bid on the building level?
- Can building principals sign valid contracts for goods and services used in maintenance projects? If so, for what amount?
- Can principals use funds from sources other than the school system to complete maintenance projects? PTA funds, Band Boosters, Quarterback Club, Pep Club.
- Who is responsible for inspecting the work of the contractor if the central administration maintenance department does not bid the project?
- What kind of staff development will need to be given to the local school building decision-makers to help them become knowledgeable about maintenance needs, priorities, and processes?
- How can the school board guarantee that preventative maintenance tasks are completed in a regular and timely fashion if the local school building can make decisions regarding how funds are expended?
- What kind of staff will the school building principal need to properly take care of all maintenance projects?

When these questions are answered through negotiations to the satisfaction of both the building and central administration, the school board can feel reasonably assured that the maintenance program of the school system will function properly and, in doing so, will maintain all buildings in a good state of repair.

Through a definition of responsibilities and subsequent allocation of authority and funding, the maintenance program can succeed. This is the only way the school board can be assured that this important administrative responsibility will be fully and appropriately discharged.□

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U.S. School Facilities Not Prepared for High-Tech Future, GAO Report Finds

As school business administrators search for ways to maintain funding at or near current levels, a new report indicates that they need to find the resources to boost the quality and amount of technological resources in the schools.

School Facilities: America's Schools Not Designed or Equipped for 21st Century, issued by the U.S. General Accounting Office (GAO) in April, reports that many schools are not ready to train their students to be technologically literate.

The GAO report found that although most schools meet many key facilities requirements and environmental conditions for education reform and improvement, most are unprepared for the 21st century in critical areas:

- *"Most schools do not fully use modern technology.* Although at least three-quarters of schools report having sufficient computers and televisions, they do not have the system or building infrastructure to fully use them. Moreover, because computers and other equipment are often not networked or connected to any other computers in the school or the outside world, they cannot access the information super highway.
- "Over 14 million students attend about 40 percent of schools that reported that their facilities cannot meet the functional requirements of laboratory science or large-group instruction even moderately well.
- "Over half the schools reported unsatisfactory flexibility of instructional space necessary to implement many effective teaching strategies.
- "Although education reform requires facilities to meet the functional requirements of key support services—such as private areas for counseling and testing, parent support activities, social/health care, day care and before-school and after-school care—about two-thirds of schools reported that they cannot meet the functional requirements of before-school or after-school care or day care.

"Moreover, not all students have equal access to facilities that can support education into the 21st century, even those attending school in the same district. Overall, schools in central cities and schools with a 50 percent or more minority population were more likely to have more insufficient technology elements and a greater number of unsatisfactory environmental conditions—particularly lighting and physical security—than other schools."

How the Study Was Conducted

"The purpose of the study was to document the extent to which America's 80,000 schools are designed and equipped to meet the needs of today's students and tomorrow's workers. Specifically, can America's schools provide the key facilities requirements and environmental conditions for education reform and improvement? Do America's schools have appropriate technologies, such as computers, and the facility infrastructure to support the new technologies?

"To answer these questions, the U.S. GAO surveyed a nationally representative stratified random sample of about 10,000 schools and augmented the survey with visits to 10 selected school districts. Our analyses are based on responses from 78 percent of the schools sampled. The study was conducted between January 1994 and March 1995."

To obtain a free copy of the report, contact GAO at P.O. Box 6015, Gaithersburg, MD 20884-6015; FAX 301/258-4066. Include the report title and order number GAO/HEHS-95-95.

Backlog Also Found in Repair and Maintenance of School Facilities

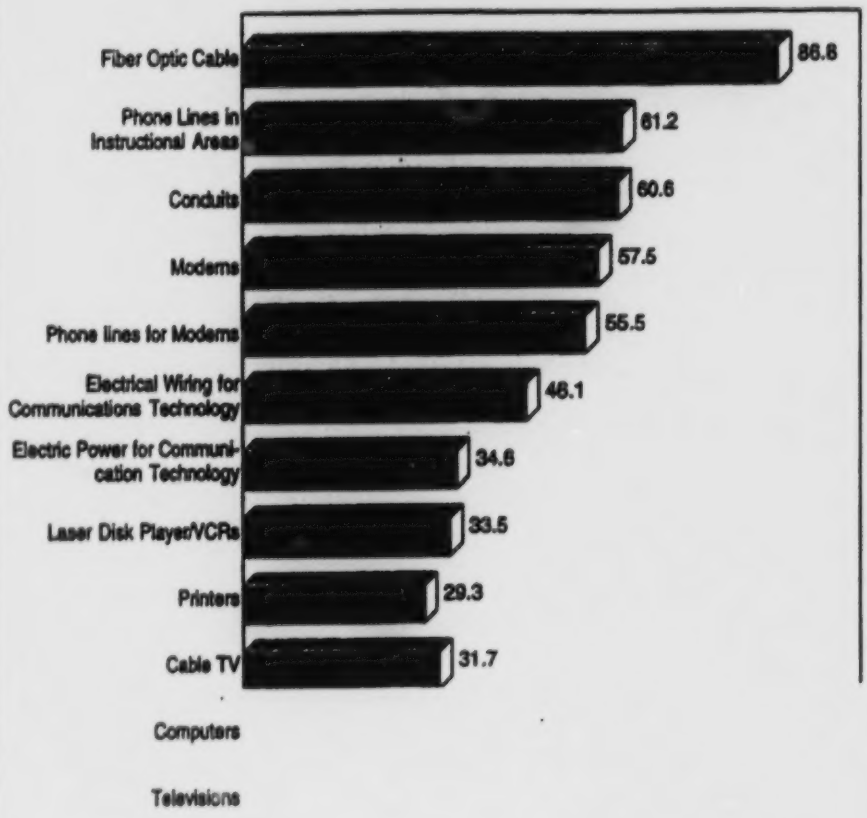
The General Accounting Office (GAO) report on technology in schools was preceded by another GAO study issued in February 1995 that addressed the condition of existing school buildings.

The study, *School Facilities: Condition of America's Schools* (GAO/HEHS-95-61), found that:

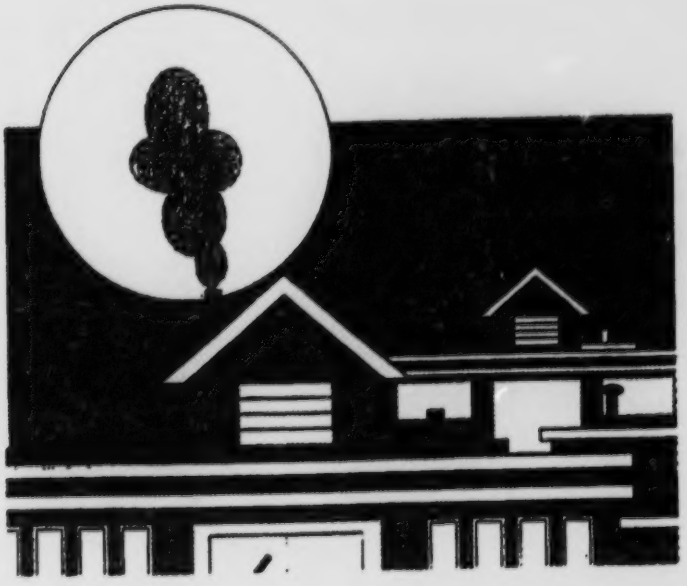
"Based on estimates by school officials in a national sample of schools, we project that the nation's schools need about $112 billion to repair or upgrade America's multibillion dollar investment in facilities to good overall condition ["Good" condition means that only routine maintenance or minor repair is required. "Overall" condition includes both physical condition and the ability of the schools to meet the functional requirements of instructional programs.]

"Of this, $11 billion (10 percent) is needed over the next 3 years to comply with federal mandates that require schools to make all program accessible to all students and to remove or correct hazardous substances such as asbestos, lead in water or paint, materials in underground storage tanks, and radon or meet other requirements.

"About two-thirds of America's schools reported that all buildings were in at least overall adequate condition, at most needing only some preventive maintenance or corrective repair. However, about 14 million students attend the remaining one-third of schools that reported needing extensive repair or replacement of one or more buildings."



Contracting Out Maintenance Services



What to Ask When Contracting for Maintenance and Custodial Services

By Graeme A. Crothall

With cutbacks the watchword, school administrators anxiously try to keep the lid on costs wherever they can without compromising essential student services. One area ripe with cost saving opportunities is school maintenance and custodial services.

Long overlooked as an area for cost containment, effective and efficient management of maintenance and custodial operations can offer much-needed budget relief. Some districts have found that maintenance and custodial services can be contracted out for less cost to the school system. However, before contracting for services, a buyer should carefully analyze and evaluate the options available. Here are some specific questions to ask.

■ **Is There A Formalized, Cyclical Cleaning and Maintenance Program?**

Calendaring maintenance and housekeeping tasks can allow for regular planned cycles for cleaning and maintenance. Tasks such as shampooing carpets, stripping floors, and washing walls can be carefully scheduled during summer breaks and vacations. A formalized approach in scheduling of housekeeping and maintenance also means paying less overtime.

A computer-driven preventive maintenance system can simplify the task of setting up the yearly maintenance calendar for each school. A good contractor will go into a new district and complete an initial inventory of every piece of equipment. Then, the contractor can load the information gathered from the inventory into a computer program; for example, the type of boiler equipment, its age, and any other pertinent data.

With this information, a contractor can set up a preventive maintenance schedule for each piece of equipment. The computer program combines the information for the major equipment throughout the school ... boiler, air conditioning, plumbing, lights ... and spreads the load of preventive maintenance over the entire year. For example, preventive maintenance on the boiler may be done one month and checking of the lighting system another.

Scheduling even minor routine maintenance check-ups, such as changing air conditioning filters, can make significant reductions in a school system's fuel bill. For example, at Lubbock Schools in Texas, implementing a program of air conditioning preventive maintenance saved the school system 15 percent immediately.

Just as important as performing preventive maintenance on a schedule is keeping accurate records of what was done and when it was done. The contractor should update the computer files with information on when the maintenance was done, who did the work, and what exactly was done.

School systems can maintain similar files and perform preventative maintenance on a regular basis as well; however, records often are kept manually.

■ **Is There A Computerized Work Order System?**

Work orders ... requests for repair, cleaning and general upkeep ... are the lifeblood of any effective maintenance system. Putting the work order system on a computer, however, brings housekeeping and maintenance into the 20th century.

In the past, when a teacher requested that a desk drawer be repaired, the request usually was made orally. Rarely did anyone report to the teacher when the work was completed. Today, using a computer-generated work order system, maintenance and repairs are not only handled more efficiently, but results also can be documented.

When the teacher asks for the desk drawer to be repaired, the date and specific request are easily logged onto the computer on a pre-printed form. With this type of documentation, the maintenance or housekeeping department can trace any work order. Say, for example, the teacher makes the request 7/10/88. The next entry records action. If parts need to be ordered, it is noted, along with the projected arrival date for parts. The teacher is sent a copy of the work order, showing specific action. This way, there is not the usual grumbling that no one is repairing the desk.

Further, the computer calendar alerts the maintenance staff of the due date for parts. If parts have not arrived by the designated date, staff can check on the parts' status. When the job is completed, the teacher is sent a copy of the work order noting the action.

■ **Can The Contractor Meet a School's Complex Scheduling Needs?**

These days schools run days, nights, and weekends. With a non-stop schedule of activities, a contractor must be capable of meeting complex scheduling needs. This means not only providing adequate staff, but also keying into a school's complex scheduling needs. For example, playing fields must not only be maintained with the grass cut routinely, but also they must be lined with lime prior to a game, and certain playing equipment such as goals or cones must be in place. This means full commitment from the contractor.

The same concerns exist for inside events. Chairs and tables, along with sophisticated (and expensive) audiovisual equipment, must be put in place for meetings. In order to be effective, the contractor must be able to keep a thorough schedule of school events as well as be flexible enough to schedule in last-minute events.

At some schools there is rarely a day when nothing is happening. Even on holidays there is a sporting event. It takes a lot of scheduling and planning to find open time to wax floors and do necessary repair and construction.

A good contractor will recognize that the student is the reason for the school's existence and work around the scheduled events. Again, computerizing and calendaring tasks helps enormously.

■ **Are Quality Controls In Place ... Such as Random Inspections?**

A policy of randomly checking equipment and spaces is an

excellent way for maintaining quality control. By taking inventory of all spaces in a school, the contractor has all the necessary data from which to work. When a contractor first comes in, every space in the school should be inventoried ... classrooms, offices, work areas, gyms. Then a good contractor will routinely inspect spaces on a schedule.

Cleaning is not like an automobile production line, where an assembly line worker screws on a part or not. Cleaning is subjective. One person's idea of thorough cleaning may not be another person's. To remove this subjectivity, a contractor can use a very intensive checklist of items for the random inspection. Then, to achieve a relatively impartial inspection, the supervisor simply marks either satisfactory or unsatisfactory for each item on the checklist.

After the random inspection is completed, the contractor should load into computerized files the results of items done satisfactorily and unsatisfactorily. From this data the contractor can analyze the quality of work being done and plot the scores of randomly inventoried spaces. These data often can point out soft spots in programs. If a certain task such as dusting venetian blinds is being missed on a frequent basis, retraining may be necessary. The system also gathers information on who did the last cleaning of that space so the exact training can be focused where it is needed. At the same time, the records give information on what is being done exceptionally well and individuals can be appropriately recognized.

■ Are Routine Reports Provided to School Administrators?

Usually, the maintenance crew is doing well to just complete the load of work assigned to them. Generating a report is something well beyond the scope of a single, local school, and many times well beyond the scope of an entire school system. A report, however, can alleviate communication gaps between the school office and the custodial and maintenance staff.

Often faculty and administrators think the custodial staff is not following through on requests or completing certain tasks. A report generated each week, however, will allow a school principal or teacher to ascertain which items of repair or cleaning are still pending and which are completed. For example, the Math and Science Department in a high school may generate a large amount of work orders each month, say 30 work orders. A report showing that the maintenance staff completed 25 of the work orders, and that only five are still pending shows the progress and convinces teachers that the maintenance staff is processing the work as requested. Without such feedback, school officials and teachers will not know how many jobs are being completed.

A reporting system creates a much better work atmosphere between school officials and maintenance staff, promoting a more cooperative attitude within the school.

■ Does the Contract Allow for Customized Services?

Not all school systems are the same. Therefore, not all maintenance contracts should be the same. Flexibility in providing services ... such as hiring an expert in the specific field can benefit some school systems. When volume merits, potential cost savings from having a heating, ventilating, and air conditioning (HVAC) expert on staff can be enormous. For example, at the Monroe School District in Williamstown, New Jersey, whenever there was a problem with heating or air conditioning, the school system called out to a local heating and air conditioning company for repair. Today, under the new contract, an in-house HVAC technician was hired. Prior to hiring the HVAC expert, preventive maintenance was never considered. The school system used the outside company only for sophisticated and costly service each time repair was needed. Under the new system, the in-house technician is utilized throughout the year, doing preventive maintenance when there are no emergency breakdowns.

Or, a school may be situated on a large parcel of land and, therefore, have very specific groundskeeping needs. Adlai Stevenson High School in the affluent suburb of Prairie View, Illinois, outside of Chicago, sits on 80 acres of land. Obviously, they needed greater attention to grounds than another school system might. Because of the client's specific needs in this area, the contractor hired an ace landscaper, who was not only good at landscaping but also had good management skills, to direct and supervise the large grounds crew.

In fact, this past year, the grounds staff at Adlai Stevenson reclaimed 20 acres of land. Where just a year ago eight-foot ragweed used to grow, today there are grassy fields.

■ Are There Financial Controls on the Housekeeping and Maintenance Programs?

It is safe to venture that no housekeeper on the payroll of a school system would guarantee that school's housekeeping or maintenance budget. A contractor, however, can.

A number of school systems use the cost-plus method ... time and material with a cap. Others go for a straight contract price. A contracting company has a very strong incentive for its managers to keep within budget and perform well. The long-term profit incentive is powerful. A single manager working at a school would not have the motivation for profit. When the company has to sell to other accounts, they rely on a proven track record of success. And, besides, they have to sell themselves again come contract renewal time.

Besides putting a cap on costs, a contractor may be able to help the school system with certain important capital improvements. Some companies will occasionally buy needed equipment for a school. This can be negotiated into the contract with the assurance that the account will be in the contractor's hands for a specified period of time in order

to help the contractor with payback for the capitalization.

■ **Is There Quality Management?**

Make sure the company provides quality management support. A good company will not sell just its program, but it will sell its management people and support people as well.

There are two distinct advantages to using a contracting company: A company can provide a range of technical experts as back-up support; and a company can provide employees upward mobility and job security that a school system cannot.

A contractor will often attract a solid, higher quality manager because they offer a career path with a name company that is growing.

What back-up support is there when a crisis occurs? For example, if there is a strike or a manager gets ill for an extended period of time, will there be back-up? Also, check the depth of back-up technical support, such as electricians, plumbers, and other skilled personnel which will be included in the terms of the contract.

■ **How Does the Contractor Supervise Employees?**

A capable contractor will insist on a certain level of productivity and efficiency in its staff ... this means adequate supervision. A contractor should routinely check staff, as well as spot check, to make sure employees are busy.

Often a contractor will go into a school system and find that very little attention was paid to supervision. Prior to the contract, it may have been a common practice for several trucks to cluster at a school for a routine repair job when only one repair crew was required. Principals are often amazed at how much more work is accomplished with solid systems of supervision, preventive maintenance, and scheduled cleaning in place.

■ **What Training Is Offered by the Contractor?**

It is very important to know what training a contractor is going to provide. For example, most companies provide initial training. Some companies, however, only provide on-the-job training, pushing the employee prematurely out into the school, and offer no classroom instruction. To get the most for the contract dollar, there should be commitment to ongoing training.

Check what the contractor shows as the cost of training new employees. It is good if they have resources such as book and film libraries on various skills. This library should be available to all employees.

An essential matter is cross-training of employees. Maintenance work can be as varied as repairing a broken pencil sharpener to working on a complex air conditioner chiller. It is the contractor's job to train employees in a variety of skills so that they

can do their jobs properly. For example, if a maintenance engineer is not strong in electrical skills, the company might send an electrician out for extra training. Through proper training, the job is done correctly the first time, which avoids costly callbacks.

A contractor may also have relationships with local colleges or technical schools, so that the school system's employees get free training at these institutions.

In the same way, a school system will want to buy management depth from the contractor. A capable contractor will offer good programs for training and developing its managers.

■ **Is There a Guarantee of Continuity and Stability of Management?**

Lack of management continuity is often the greatest area of criticism by school administrators of contractors. It is perfectly reasonable to ask that it be written into the contract that the school system will not lose its manager in the first three years of the contract.

Should a unit manager become ill or have to leave a position in midyear, the contractor should be willing to make every effort to maintain continuity on the account. A capable contractor should be able to shift a manager in from another location or even another division. This individual will have had the same company training and be familiar with the systems in place. Therefore, the school system experiences no down time.

■ **Are There Any Added Benefits?**

School districts should see if there are any auxiliary benefits attached to signing with a contractor. If the contractor does a substantial business, it may be able to buy some products and services more cheaply than the school system. The contractor may get bulk buying discounts for certain cleaning products. Or, the contractor may already have excellent buying relationships with local vendors, enabling the school system to piggyback onto attractive rates for products and services.

Through its years of experience, a contractor often can reliably steer the school system to quality vendors of products and services. Also, some contractors can offer construction services on a project basis ... painting, roofing, and replacing outdated equipment when necessary.

■ **Who Payrolls Maintenance and Custodial Employees?**

It is the school district choice of whether to simply use the contractor for management and keep employees on the payroll, or move the staff onto the contractor's payroll. Although it is not always true, a contractor often can have lower insurance rates than the school system. Also, a contractor's fringe benefit package costs may be lower than the school system.

A decided advantage of moving employees to the contractor's payroll is the easing of human resources administration and recordkeeping for the school system. For example, when moved into the contractor's hands, payroll, insurance, worker's compensation, medical, dental, and life insurance matters are handled by the contractor. It may be more economical for the school system to have the contractor administer these matters. Since statistically maintenance and custodial are typically high turnover positions, the school's employment office is not burdened with the high costs of moving people onto and off of the payroll.

■ **What Is the Financial Viability of the Contractor?**

Schools are typically slow in paying their bills. If payment is delayed, ask how the contractor will meet payroll. Or, more importantly, will the contractor be able to stand behind the bid if there are sudden price increases? Often, a low-bid contractor cannot afford to stand behind the bid, and must cut staffing and quality. Worse, the contractor may use substandard equipment in repairing school machinery.

On large maintenance contracts where over a million dollars are involved these are essential matters. You want to make sure the contractor has the resources to stand behind what is promised?

■ **Does the Contractor Have a Record of Delivering What Is Promised?**

What is the company's track record? A few phone calls to clients and former clients will begin the process of verifying the company's reliability. A school system should ask for and receive from all bidding contractors the following three items: (1) A list of all school district business within a 500-mile range of the school system where the bidding is taking place; (2) A list of all contracts lost within the last three years; and (3) A client reference list.

Then, someone should go take a look at another school district where the company has a contract. Besides seeing if it looks clean and equipment looks well maintained, find out if the systems the contractor has promised are actually in place. Ask if there is quality control and if the company provides employee training. Find out if the contractor promises a set number of workers and then delivers on the promise, or if the contractor has shorted clients on the number of workers and the hours they work.

By asking the right questions, school districts can find out whether contracting for maintenance and custodial services is a good option.□

Graeme A. Crothall is Division Vice President, Facilities Management Division, Marriott Corporation, Washington, D.C.

Maintenance Services

Keeping Them In-House or Contracting Them Out

CONTRACT OUT

◆ By Larry C. Fenster, P.E.

As we approach the beginning of a new century, many critical issues face our community leaders and educators. How to achieve and maintain a high quality educational system is chief among their concerns. In the area of school maintenance, there are three basic choices:

- Operate physical plants in the traditional manner;
- Employ a Contract Management Service Provider (CMSP) to manage the plant; or
- Combine a traditional approach with a mixture of assistance from consultants and contractors.

Whichever method is chosen, school administrators must find viable solutions to the vexing operational issues of the 1990s:

- The growing volume of deferred maintenance (estimated at over $100 billion) which threatens the capital investment in schools;
- The increasing regulatory compliance burden;
- The spiraling costs of new construction and renovation projects;
- The escalating costs of energy; and
- Increasing labor and supply costs.

The premise of this article is that communities need to concentrate their education resources on their most important task: educating their youth. It is through education that today's students will grow to become tomorrow's productive citizens and leaders.

Prior to 1950, educational facilities could best be described as "cast iron." Heating was accomplished with cast iron radiators that required virtually no maintenance, were designed to last forever (give or take a few "clanks"), and had no control systems other than on or off. Boilers, by today's standards, were relatively inefficient with poor burner efficiency and low heat-transfer rates. Air conditioning was by opening or closing a window, and there were no sophisticated HVAC controls or electronics systems.

Since then, educational facilities have been built on a foundation of increasingly sophisticated technology as demanded by the communities. Modern heating and ventilation systems require highly skilled technicians and technical support to be properly utilized. Automatic control systems that monitor energy usage and maintain comfortable classroom environments also require well trained personnel who understand the underlying complexities of these systems.

The costs of constructing and maintaining these new high-technology facilities, while simultaneously supporting the antiquated buildings of the 1930s and 1940s, has staggered school administrators and taxpayers. Operating budget cuts and taxpayer resistance to new bond issues have made it increasingly difficult to fund even the most basic maintenance programs that balance corrective and preventive maintenance. Furthermore, training programs to maintain required technical skills for maintenance employees are difficult to justify when dollars for basic education programs are evaporating in today's economic environment. The right contract management service providers (CMSP) will provide your schools with cost-effective solutions to these issues.

Deferred Maintenance

Of primary concern to the schools should be deferred maintenance. The definition of deferred maintenance changes with the political and economic environment, but generally speaking, it is the total value of those actions needed to:

- Correct structural or electro-mechanical deficiencies that could endanger the integrity of the

building or the building environmental systems;
- Ensure compliance with all applicable codes and standards; and
- Complete energy efficiency improvements, building alterations, and other facility modifications to meet changing community needs.

A quality CMSP will professionally analyze the backlog of deferred maintenance and implement management solutions that economically bring the school system maintenance program back under control. The qualified CMSP will evaluate all school buildings, identify all equipment and maintenance to be performed, and use a computerized maintenance management system to prioritize all maintenance. This is an opportunity for school administrators and the CMSP to reach agreement on the scope and time frame for work to be performed. A quality CMSP will provide you with the following benefits in this area:
- A professional manager trained to properly utilize the computerized maintenance management system;
- A software package customized to the education market;
- A national database of standards for all equipment that defines what must be done and how long it should take;
- A broad base of technical expertise that is electronically accessible; and
- A program that is results-oriented.

Identifying what needs to be done and setting the priorities is only part of addressing the deferred maintenance problem. Recruitment of the right people and training of the existing staff will set the stage for success. Here again is an opportunity for the school since the CMSP will have the tools and experience to find and train the right people. A quality CMSP will have a systematic, objective interview format based on a profile of standing maintenance service employees to identify those applicants with the attributes necessary to achieve excellent service in the maintenance department.

Both new and existing maintenance employees must be adequately trained on how to properly and effectively utilize their tools. A quality CMSP will provide training opportunities and programs to fit the needs of each maintenance employee on the staff. Training must span topics from literacy to advanced electronic control systems and should lead motivated individuals toward earning accredited advanced technical degrees. The right CMSP will have a standardized training and evaluation process backed by a degreed education staff. You should expect a significant reduction in employee turnover and greater productivity.

As the right people are hired and the effects of training are realized, the backlog of deferred maintenance actions will be reduced to manageable levels. The benefit of proper recruitment, training, and prioritizing of maintenance tasks will be a balanced maintenance program that is designed to control deferred maintenance and deliver the following results:
- Extended equipment life;
- Reduced disruption to the operations of the school;
- Minimized liability to the school; and
- Controlled operation costs for the school in the areas of labor, utilities, purchased services, and supplies.

In short, you should expect to get the physical plant back under control with little or no additional expense. The CMSP can also bring much more to the school yard than solutions to deferred maintenance.

Management of the Regulatory Burden

A quality CMSP will be well equipped to deal with codes and regulations. Modern schools must function within a very complex regulatory framework. Gone are the days when the only regulatory body of concern was the local school board. The Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), the Food and Drug Administration (FDA), and the Department of Health and Human Services (HHS) are the driving forces behind the regulations and directives which modern school administrators must follow. Failure to comply with these agencies' directions and requirements can result in significant financial penalties and could cause the school to be closed down.

All of these regulatory actions have caused significant administrative and financial burdens on an already stretched educational system. To help manage the impact of these requirements, a quality CMSP will have the resources in place to identify changes in the regulatory environment and to inform you of their potential impact on your operations in a timely and proactive manner.

Facing New Technologies

The CMSP must also help school administrators address the maintenance concerns of the new, high-tech school equipment. It must function as a single source provider for managing not only the maintenance of electro-mechanical equipment, but the electronic equipment in the schools as well. High-tech photocopiers, central computer systems, FAX machines, personal computers, VCRs, TV monitors and other audio-visual equipment are commonplace in today's schools. Providing comprehensive technical support for these new systems has become increasingly more complex, time consuming and costly. The quality CMSP, using a holistic approach to the technical environment, will provide a custom-tailored program blending the following:
- On-site management and maintenance services;
- Vendor service agreements;
- Time and materials contracts; and
- Maintenance insurance.

The program should be specifically designed to fit your school system's needs in an easy-to-administer program. Through efficient planning, based on equipment histories, you can expect the CMSP to reduce surprise replacement bills, overstaffing and excessive outside repair services. The benefit to the

school is that both the budget and the covered equipment continue to operate smoothly and efficiently while the school system has a single point of accountability. High tech equipment can be a troublesome concern to school administrators, but to the service provider, it is an opportunity to help the school enhance its programs using the right technology tools without the high financial maintenance risks.

The Rising Costs of Energy

Rising energy costs over the past decades have removed hard dollars from educational programs. Here again, there is opportunity for both the school and the CMSP. Since approximately 50 percent of the maintenance department budget is devoted to energy costs, reducing energy consumption can dramatically affect the maintenance budget and in turn, free up dollars for education programs. Replacing outdated, inefficient boilers, chillers and the like can have a dramatic effect on energy consumption.

Capital funding for such retrofit programs, however, is typically a problem for school districts. Fortunately, large CMSPs have the capital funding available to them for large energy retrofit programs that are guaranteed to save enough energy to pay back the cost of capital, return money to the school in terms of energy savings, and provide a reasonable pay back on investment. The mathematics are straight forward and the results are easily measured.

Your CMSP should be very knowledgeable about utilizing power company rate structures to drive your energy cost downward. A quality CMSP will have a well-trained, skilled support organization that can provide additional research. You should require the CMSP to provide computerized statistical models, which are typically unavailable to school systems, to predict and manage energy consumption.

Customer Support

The overriding goal of the 1990s will be "do more with less" in the education marketplace. The CMSP can assist a school system in meeting this goal. A quality CMSP will have a broad base of knowledge, an "information warehouse," from experience in hundreds of school systems. You should expect a progressive CMSP to have established a National Management Support Call Center to review and respond to your ever changing environment.

The "information warehouse" is a gold mine for schools, provided there is a central point of contact for accessing the data. A National Management Support Call Center, staffed by experienced personnel, can cost effectively deliver information and advice via phone, FAX, and electronic mail, providing immediate turnaround on a request. The electronic response, while not a replacement for on-site inspections on highly technical problems, will provide more information and expertise in less time for less expense.

The Future

CMSPs will continue to evolve and expand to address the unique needs and requirements of each school system. Some schools will need Computer Aided Facility Management (CAFM); a graphics computer environment that provides visual feedback for planning, space management, maintenance management, and the entire realm of support services. Others will only need access to a broad information base; the National Management Support Call Center can provide information on both a reactive and proactive basis for handling operational issues as well as measuring results. The best CMSPs, because of their size and breadth of knowledge, will be able to provide all of the services outlined in this article in a custom-tailored program for each school community. With experience in hundreds of educational facilities, the CMSP will bring resources to a school system which would be impossible for the system to develop on its own in a cost-effective manner.

While the maintenance environment for schools is difficult because of the plethora of issues,

TABLE 1
What to Ask a Contract Management Service Provider

Do you have:

- Tools, custom tailored to the school market, for planning, scheduling, tracking and reporting on deferred maintenance and the productivity of the people performing the work. Ask to see the reports.
- A written, standardized profile defining the attributes of quality, service oriented maintenance applicants. Ask to see the form.
- Training programs that address basic personnel and job skills to bring dignity to the work place. Review the material.
- A local management and support presence. Ask for names and addresses.
- A National Management Support Call Center, accessible 24 hours a day, to address regulatory requirements and technical questions. Ask for the number and give them a call.
- Capital and qualified engineers to plan, manage, and complete energy retrofit programs. Ask them about their previous projects.
- The qualifications, experience, and programs to service all the maintenance needs in schools, both electro-mechanical and high-tech equipment. Go see it working.
- Measurable results, goals, and objectives. Ask to see them in writing.

BEST COPY AVAILABLE

by providing expertise, controls, information, and capital, the right CMSP can provide opportunities for schools to focus their resources and finances on their most important job: educating the youth of America to be tomorrow's productive citizens and leaders.□

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KEEP IN-HOUSE

◆ By Nick Viscio

Many school administrators are led to believe that a contract cleaning firm can perform custodial and maintenance services at a lower cost than in-house departments, and that it will relieve administrators of bothersome custodial and maintenance problems.

On this point, I believe it's important to take a firm stand. A well run in-house department has many advantages over a contract cleaning service. An in-house staff is able to select the best products and services to maintain the institution and achieve longevity of furnishings, buildings, grounds and equipment.

A properly trained in-house staff is always available to handle emergencies, special projects and last minute changes. The in-house staff, therefore, has the very important advantages of control, flexibility, efficiency and, when properly managed, loyalty in interdepartmental relationships. And, in security matters, there is a great advantage in working with a staff that has been screened and hired by the superintendent of buildings and grounds.

Another plus is the availability of the buildings and grounds staff to handle many duties. Every building and grounds superintendent, at no extra cost, can handle interior decorating, carpet selection, relocation planning, budget planning, roofing, windows, heating, electrical matters, pool maintenance, etc.

It is an advantage to an administrator when he knows he is working with a buildings and grounds superintendent who answers directly to him, and who is qualified to perform the requisite duties.

A positive relationship between the administrator and the buildings and grounds superintendent is important for the growth and well being of an institution. If this relationship is weak and lacks direction, the total operation suffers. Without an honest and sincere delegation of both authority and responsibility from the administrator to the buildings and grounds superintendent, the relationship falters.

Following are some points that the buildings and grounds superintendent should consider:

- Do you tell your people they are doing a good job?
- Do you have meetings with your staff and administrators?
- Do you inspect your premises from time to time with your staff or administrators?
- Did you help prepare your budget?
- Do you know how you stand in your budget from month to month and quarter to quarter?

Administrators should be made receptive to new developments in supplies and equipment. Labor-saving devices are continually being developed; they can reduce non-productive time, and improve efficiency and results.

Reasons for Keeping It In-House

I regularly hear about school districts that try to use contract cleaning and maintenance service firms. Usually, they keep them for a year or so and then go right back to a solid and more dedicated in-house staff.

One reason for the renewed interest in contracting out is the current recession, and federal, state and local budget cuts. Contracting out is not the easy answer for the tough fiscal problems faced by school districts today. The principal reasons that school districts hire outside contract companies are for expected cost savings, better quality housekeeping, and expertise. Other reasons are fewer employee problems, an end to having to purchase supplies, expectations of accountability and better trained personnel. Districts listen to the companies' sales stories and feel they could bring valuable support.

In the end, however, I believe a school is better off staying with its in-house staff. Here is why:

Lower Costs. Even though a service is contracted out, school districts must still bear the cost of contract administration including preparation of the contract and monitoring of a contractor's performance. Also, private companies' expenses for services may be greater because they must make a profit and pay taxes. These factors do not affect the cost of publicly performed services.

Better Service. Since the objective of private firms is to maximize profits, companies are always looking to "cut corners." They may try to make their profit by limiting staff size and the overall quality of products used. These actions may result in decreased quality and quantity of services. Again, monitoring is necessary to detect this decline.

Guaranteed Service. Contractors may cease or curtail operation because of bankruptcy, financial problems, lack of equipment or for other reasons. This could leave a school district without services and cause severe hardship.

Philosophical Control. With in-house services, you get to decide "what is good enough," and "how clean is clean."

Stability. I have known contract firms that have used schools as training grounds for their managers, frequently changing the supervisors. This prevents a relationship from developing between the school administrators and staff, and the person in charge of maintenance. In-house maintenance supervisors usually have a long-term commitment to their jobs.

In-house custodial and maintenance services strive to do what is in the best interest of the students and staff. The school district employee is strongly conscious of how his work affects the students and staff; the contract employee is conscious only of man-power hours. The school district employee performs his work out of dedication to duty first; the contract employee will perform service only for a fee and will cut corners to cut cost. The district employee will re-schedule work; delays mean time and money lost for the contractor.

If there is dissatisfaction with the performance of a given in-house service, managers should not assume that contracting is the answer. Much can be done in-house to improve the cost and quality of the services. After all, managing a custodial and maintenance department is no different than managing any other department, the same principles of good organization apply: planning, organizing, staffing, directing, controlling, and educating. With competent management, there should be no need to ever consider contracting out.

My own experience with contract cleaning services began in 1979 when I went to work for a district that had been contracting out services for many years. I found the situation very difficult to control.

Each year bids went out for cleaning services and each year a new contractor was chosen because of a lower bid. The services were always the same, terrible. I had very little control and each day the principals would complain about the conditions of the buildings. On nightly visits to the buildings, I usually found different people working because of turnover. Morale of the regular custodial staff was low because they felt ineffective in dealing with outside people.

After five years of frustration, the board of education agreed to a change. The district switched to in-house personnel and a few amazing things happened: the district saved money, the buildings were cleaner, the principals and staff were happy.

Does it make the buildings and grounds superintendent's job easier? No. But we are employed to maintain school facilities in a professional manner for the safety and welfare of all occupants.□

Nick Viscio is Director of Facilities and Operations for the Syosset Central School District, Syosset, NY.

Maximize Benefits, Minimize Risk

Selecting the Right HVAC Firm

By James T. Golden

Two years ago, maintenance crews at the Painesville Township Schools, Painesville, OH, were drowning in work orders — with no relief in sight.

"We were usually running behind to correct an error, a breakdown or a failure," says Alan Wolf, the school district's treasurer. "We were always reactive rather than proactive."

Today, all that has changed. A $1.2 million energy management retrofit — that also financed $400,000 in much-needed roofing repairs — has put Painesville's maintenance crew back in the driver's seat. The district-wide retrofit project restored and upgraded mechanical systems in 10 buildings and computerized energy management controls were installed at all nine district schools.

With heating, ventilating and air conditioning (HVAC) systems and lighting systems now operating at peak efficiency, and with an outside firm maintaining the system and guaranteeing savings for the next 10 years, the staff no longer spends its time "putting out fires." Instead, Wolf says, his people are back in the preventive maintenance business. Now, they can focus their efforts on areas not covered under the new maintenance agreement.

Painesville's successful energy management project is an example of how school districts nationwide are creatively using outside contracting firms to regain control over HVAC operations. Some districts, like Painesville, use energy management projects with guaranteed savings to upgrade their facilities and finance much-needed building repairs. Others use outside firms to varying degrees to help them shave operating costs and to comply with building-related health and environmental guidelines.

The financial incentives for improving HVAC maintenance practices are considerable. Good preventive maintenance measures alone can — on average — cut energy consumption levels by up to 12 percent. They can also extend useful equipment life by as much as 10 to 15 years.

When competent outside firms do the work, these benefits multiply. School districts find they need to invest less in tools, parts inventory and training (one of their biggest costs). They also experience fewer emergencies, run up less staff overtime and experience less downtime due to scheduled shutdowns or emergencies.

Tom Franklin, a senior consultant with the Council For Great City Schools, says reduced staffing and training requirements are "a major benefit" of contracting out HVAC work. He predicts school systems will increasingly rely on outside firms because many urban school districts now lack the training and resources to do the work in-house and because deferred maintenance "is in a critical state" and getting worse all the time.

"Maintenance is really a major, major issue," he says. "And it will continue to be for our school districts because so many cities are dealing with aging infrastructures of their own in addition to their schools'."

An informal survey of 20 major urban school districts, prepared for this article, found that 40 percent were currently operating in a "break down" maintenance mode and that only 25 percent were maintaining their lighting, heating and air conditioning systems at "optimum efficiency." A majority (57.9 percent) also indicated they saw considerable benefits in contracting for HVAC maintenance services with outside firms. ("Survey of Major Urban School Districts").

Merely choosing to go outside for HVAC maintenance services does not guarantee a successful experience. You have to know how to select qualified firms. Otherwise, you could wind up with improperly installed and maintained building systems and costly, protracted problems. In a 1990 report, analysts at the Lawrence Berkeley Laboratories, who studied energy management retrofits in more than 1,700 commercial buildings, said poor preventive maintenance was a major reason why savings "often fall well short

Survey of Major Urban School Districts

What is the present condition of the mechanical and lighting systems of some of the United States' largest urban school districts? And what are the attitudes and concerns of facilities managers and school business officials regarding preventive maintenance, indoor air quality and energy management?

To find out, NEMI faxed a questionnaire on these issues to all 43 member districts of the Council of Great City Schools. While only 20 responded, they represent every geographic corner of the continental United States, from Boston to Sacramento and from Broward County, FL to Portland, OR.

The survey shows that, as a group, these districts are clearly "sold" on the benefits of preventive HVAC maintenance for improving energy savings, indoor air quality and prolonging equipment life.

Yet it also confirms the general state of disrepair into which most major urban school districts have fallen. Of those districts surveyed, 60 percent either disagreed or disagreed strongly with the statement that their school district's lighting and HVAC systems are "presently maintained at optimum efficiency." Only 25 percent said their systems were being optimally maintained.

Meanwhile, deferred maintenance continues to be a major problem. The districts split evenly in their response to the statement, "We do *not* operate in a 'break down' maintenance mode." Of those responding, 40 percent said they do, 40 percent said they don't and the remainder were undecided. The majority of the school districts clearly see the value of going "outside" for HVAC assistance. Only 11 percent felt that going outside offered "few benefits" for school districts, while 58 percent either disagreed or disagreed strongly.

Survey Results
Sample Size: 20 major school districts from the Council of Great City Schools

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
A good preventive maintenance program *can* significantly improve energy savings and indoor air quality in school facilities.	0%	0%	0%	25%	75%
Our school system's lighting, heating and air conditioning systems are presently maintained at optimum efficiency.	5%	55%	15%	25%	0%
Contracting for maintenance services with outside heating, ventilating and air-conditioning companies offers few benefits to school districts.	11%	46%	32%	11%	0%
A good preventive maintenance program can significantly prolong building equipment life.	0%	0%	0%	15%	85%
Our maintenance people know what building systems and equipment we have and what their maintenance requirements are.	0%	15%	0%	60%	25%
Right now, improving indoor air quality is *not* a high priority for our school system.	45%	40%	5%	5%	5%
Right now, saving energy is *not* a high priority for our school system.	55%	35%	10%	0%	0%
We do *not* operate in a "break down" maintenance mode, meaning we do not generally wait until systems fail to service and fix them.	5%	35%	20%	15%	25%

of economically optimum levels."

In addition to poor savings performance, school districts that fail to properly maintain their HVAC systems risk exposure to lawsuits if they allow their indoor air quality to deteriorate below safe, recommended levels. They also may now be subject to stiff fines — or worse — for knowingly venting CFC or HCFC emissions into the atmosphere through poorly maintained air-conditioners, refrigerators or chillers.

All of this makes choosing the right service provider — and the right maintenance package — more critical than ever. To reap the benefits of outside maintenance support school districts need to be very deliberate in how they go about picking HVAC maintenance firms.

What Should Drive Your Decision?

With the stakes as high as they are, pure price-driven competitive bidding is rarely the answer. Instead, school districts need to put the delivery of consistent, reliable, quality service ahead of virtually any other concern. Otherwise, you run the risk of attracting and selecting firms that undercut reliable bids in order to get work and then fail to deliver desired levels of service.

Price-driven bids may actually invite trouble. "Most maintenance contracts specify routine maintenance procedures only," says Dean Steward, president of Heating & Plumbing Engineers, Colorado Springs, CO. "They don't include parts or the labor needed to install them. It's easy for an unscrupulous contractor to go in cheap on a few items and then turn around and gouge the customer."

Steward says building maintenance, like car repair, depends largely on trust. "Once the contractor's on the job, he can find new problems or tell you parts are failing, causing his work — and your bill — to expand."

"Remember," he says, "price doesn't define service. Price doesn't define performance. Price doesn't define trust."

Don E. Croy, P.E., president of CAER Engineers Inc., a nationwide engineering firm, says not all bids are on the mark. In some cases, competing bids may not even be in the same ball park. Croy cites one school district HVAC project in which the winning bid came in at $500,000 and the high bid came in at $1 million. "Obviously," he says, "that guy who bid high didn't know what he was bidding on. That's another problem. There's not a lot of experience — even with large service companies — bidding on something like this."

"School districts need to put the delivery of consistent, reliable, quality service ahead of virtually any other concern."

Negotiated Contracts

One way to assure quality service is to rely on negotiated contracts and a selective process to find an appropriate firm, rather than to indiscriminately send out Requests for Bids. Under the selective process approach, you prequalify several companies that meet your service needs and then invite them to examine your facilities and make proposals for a comprehensive maintenance program. After reviewing and ranking the proposals, attempt to negotiate an agreement with your first choice. Failing in that, proceed to your second choice and so on.

One benefit to this approach is that it encourages the selected firms to invest the necessary time and effort required to prepare truly customized and creative proposals. Often, these will contain value-added ideas and services that might not otherwise have been offered.

Getting Started

Before selecting bidders, you should determine what kind of services and capabilities you will need. And, the experts say, the only way to determine this is to complete a full inventory and assessment of your buildings' mechanical and electrical systems and equipment. "Before you can select an appropriate outside firm, you need to know what equipment you have and what condition your equipment is in," says Pat Sedillo, head of the Facilities Management division of Miller Metal Co., Inc., in Albuquerque, NM. "Otherwise," Sedillo says, "you're operating in the dark."

Sedillo should know. Before coming to Miller Metal, Sedillo directed maintenance and operations for the Albuquerque School District. There, he says, he used a combination of preventive maintenance and energy management measures to cut emergency calls by 60 percent and save $6 to 7 million in energy costs over a four-year period.

Sedillo recommends that school maintenance departments work with an outside consultant to complete the building assessment. The district's staff should become "a part of the process."

Don Croy says schools should also consider retaining a financial

"Financially sound companies should have no trouble keeping sufficient parts, equipment and personnel on hand to deliver consistent levels of service throughout the contract period."

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management consultant familiar with school operations to help determine what services, if any, should be put out to bid. Some project management firms will provide both engineering and financial management services to schools still in the planning phase. Croy says the financial side is often more complex than the engineering. "It's hard to put numbers on current spending unless you're a financial genius and know all the ins and outs of school districts," Croy says. "There are a lot of hidden costs that don't always pop out at you."

Some important cost factors to consider include:

- The size of your maintenance budget;
- Your average yearly losses from equipment failures;
- Any anticipated building improvements and equipment repairs;
- The projected number — and desired skill levels — of both in-house and contract maintenance staff;
- All training costs required to achieve those skill levels;
- The tools and heavy equipment you will require the contractor to provide;
- The cost of security/background checks of service personnel; and
- The amount and cost of liability insurance you'll want contractors to carry.

Building A Select Bidders List

Once you have identified your needs, the next step is to field a list of prospective bidders. The quickest, easiest and, perhaps, smartest way to do this is to take referrals. Pick up the phone and call school business officials in neighboring districts. Find out if they have ever used outside firms and if so, ask whom they would recommend.

Speak to your local trade associations and your fellow members. Contact the local chapters of groups such as the Sheet Metal Air-Conditioning Contractors National Association (SMACNA) and ask for names of reliable building contractors. The information and background you receive from these sources can save you countless hours. (See "Where to Find Qualified Contractors")

Request For Qualifications

Next, prepare a formal Request for Qualifications, and send it to each of your prospective bidders. Provide some brief, descriptive information on your school district and facilities, and then request as much information on their firm and capabilities as you need. The goal here is to narrow the field of potential bidders to the two or three who will best meet your specific requirements.

You may want to start by asking them for a list of their existing service clients and a description of the nature and scope of the work they do for each. Then, have them

Where to Find Qualified Contractors

Where can your school district turn for the names of qualified, local HVAC maintenance firms skilled in energy and air management? The three trade associations listed here provide an excellent starting point.

Two of these nonprofit groups train and certify their members in the specific skills you're looking for—and they know their members' capabilities inside and out. All three provide some type of free referral service and will be only too happy to assist you in your search.

The National Energy Management Institute—Founded in 1981 to improve the training and professionalism of energy management firms, NEMI has since trained and certified more that 1,600 Energy Management Technicians and 250 Energy Management Contractors nationwide. Today NEMI continues to promote the development of more energy efficient, healthful indoor environments by stressing a comprehensive **Total Energy and Air Management**™ approach in its training efforts. The organization also guarantees—and insures—the projected energy savings on any NEMI-approved project completed by a NEMI certified contractor.

To learn the names of NEMI certified contractors in your area, simply call NEMI, toll-free at 800/458-6525.

The Association of Energy Engineers—The AEE is an international professional society with 8,000 members in 52 countries and 40 cities. AEE offers certification in each of the following areas: Certified Energy Manager, Certified Cogeneration Professional, Certified Energy Management Systems Contractor, Certified Lighting Efficiency Professional and Certified Indoor Air Quality Professional.

For referral assistance, AEE will provide you with the names and telephone numbers of chapters—or members—in your area. You may either write AEE at 4025 Pleasantdale Road, Suite 420, Atlanta, GA 30340, or call at 404/447-5083.

The Sheet Metal and Air Conditioning Contractors of North America—SMACNA is an international trade association representing 4,000 contributing contractor firms active in some or all phases of HVAC system design, testing, maintenance, installation and fabrication. Since its founding in 1943, SMACNA has set numerous national and international standards for sheet metal and HVAC work. The organization maintains 109 active chapters in the United States and Canada, and they all provide free referral services. For a list of SMACNA chapters near you, write SMACNA's national communications department at: 4201 Lafayette Center Drive, Chantilly, VA 22021, or call: 703/803-2980.

indicate whether these are institutional, industrial, light commercial, commercial or small business clients. Ask them how they would handle account management. Would you be assigned a single, accountable contact person or a list of beeper numbers?

Find out how many years they've been in business, the size of their service fleet, and the size and training qualifications of their service staff. Ask for some history of their company. Is it, for instance, a family-owned and operated firm? (Often, these firms enjoy less staff turnover and work better together.)

What is their range of capabilities? Are they limited to performing routine service maintenance, or are they a full-service firm, capable of providing engineering, architectural and mechanical building services to improve indoor air quality, energy efficiency, comfort and safety?

Finally, ask them to provide you with audited financial reports and a complete list of references that includes current and past customers.

Narrowing The Field

Who should make your final bidders list and receive Requests for Proposals? Firms that can at least demonstrate the following:

- Excellent references;
- Solid finances;
- Five or more years of successive business history;
- Enough staff and equipment to handle your anticipated needs;
- Field personnel trained and qualified in preventive maintenance, indoor air quality and energy management;
- A familiarity with the equipment — and systems — in your building;
- Sufficient records of field personnel training programs, course outlines and completion certificates to demonstrate proficiency in the skills you need;
- Adequate field personnel safety training to meet your requirements;
- The correct test equipment to handle your system's needs;
- A good, working relationship with equipment suppliers, related contractors and trade groups;
- Access to qualified engineering expertise;
- Quick emergency response time; and
- A computerized communications and dispatching system that can provide detailed records of all completed service calls and affected equipment.

Financial strength is important because it assures you of continuity of service. Financially sound companies should have no trouble keeping sufficient parts, equipment and personnel on hand to deliver consistent levels of service throughout the contract period. They should also maintain good credit references so that you're protected from exposure to mechanic's liens.

A service company doesn't have to be big to be good, but it should have enough available resources on hand to provide prompt service, 24 hours a day. Make sure the firm you choose has enough trucks on the road to provide you with two-hour emergency service. Generally speaking, avoid firms whose nearest office is more than 100 miles away. At that distance, companies can rarely provide same-day service.

A demonstrated history of safety-consciousness is also important. Firms that provide their service people with extensive safety training are less likely to suffer injuries on the job (i.e. on your site). That means you ll experience less service staff turnover, greater service reliability, and a reduced risk of becoming involved in worker-related injuries.

"Be sure to ask for all hourly rates and mark-ups in advance, and insist on your right to pre-approve all repair work."

Look for firms that affiliate themselves with reputable professional and trade associations.

Because trust is such an important issue, you need to check references thoroughly. However, you will do best to limit yourself to former customers who had retained the firm for at least a year. (It often takes a year or more for problems to surface.)

Ask these former customers about the initial quality of work and about their satisfaction with the follow-up service and any ongoing training and support that the company may have offered. Don't limit yourself to references the contractor provides, either. Call facility managers and school business officials you know for added input. Often, they will be happy to share their insights with you.

"Firms that provide their service people with extensive safety training are less likely to suffer injuries on the job (i.e. on your site)."

Avoiding Problems

By following this deliberate process, you will greatly increase the odds that you will be happy with the maintenance firm you ultimately choose. But a few more safeguards are warranted.

If you are considering entering into multi-year maintenance contracts that do not directly support savings guarantees, limit them to one year. Do make them automatically renewable and include a 60-day cancellation clause, that allows either party, for any reason, to discontinue the contract.

Scott Pargin, vice president and

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general manager of Young & Pratt Service, Austin, TX, says such a "kick-out" clause is fair to all parties. "You're not in a win-win situation if for some reason you have a contractor come in who cannot perform for the school or the school is not happy. If the contractor pulls out," he adds, "then the next qualified contractor should get the job."

Be sure to ask for all hourly rates and mark-ups in advance, and insist on your right to pre-approve all repair work. Also, require the contractor to let you inspect any and all replaced parts, at your request. It's also a good idea to require the maintenance firm to assign a single account manager to your facility.

You may also find it useful to spell out important details of your working relationship in a procedures manual which you can refer to in your service agreement.

Include a task sheet in your project specifications that specifies the minimum number of hours required for each type of service work to be performed on each piece of equipment. "That way," Pargin says, "everyone will be bidding on the same level of service and everyone will understand that is the level of service they will have to provide."

If your outside contractor is performing any energy management or controls work, Pargin says, you should make sure the contractor agrees in writing to guarantee the energy savings. "That will help you narrow the field to good, credible people who are willing to put their money where their mouth is," he says.

Finally, you must get your own in-house maintenance people behind the new service arrangement from the outset. They must want to support and participate in the process if it is to be successful.□

James T. Golden is the administrator for the National Energy Management Institute (NEMI) in Alexandria, VA. NEMI is a non-profit organization dedicated to creating more energy efficient, healthful indoor environments for all Americans. Through its efforts to promote Total Energy & Air Management℠, NEMI certifies and supports energy management contractors and technicians.

Maintenance and Custodial Services

Getting the Most for the Money

By Gregg Miller

Today school business administrators are hard-pressed to find ways to cut school budgets. Nonetheless, they are always eyeing new options to save money without compromising essential student services. An area long overlooked for budget relief and cost containment is effective and efficient management of custodial and maintenance services. Administrators find they can often contract out such services at a substantial savings to the school district and at the same time improve the quality of services.

On-Site Management Team

As educators focus more on their mission—educating children—they are recognizing the many benefits of letting private companies manage support functions. Management companies such as mine, Marriott School Services, are experts at what they do. They have technical expertise on the best ways to clean, wax floors, wash walls, handle chemicals, maintain strict fire safety and successfully meet regulatory requirements. Management companies routinely test new methods of training and supervision, maintain ongoing programs to test new cleaning products and invest heavily in research and development for new equipment.

By using a management company, a school business official eliminates the day-to-day worry of keeping buildings clean and operating efficiently. Moreover, a school district gains the added value of a skilled on-site team, often times backed up by regional corporate support. For example, a large, nationally-known company can offer enormous buying power in purchasing equipment and supplies not available to individual school districts. A management company can also offer technical expertise in highly sophisticated fields such as electrical, engineering, construction management, architectural design, regulatory compliance and labor relations.

One of the very real differences in using a management company is their proven system of management. Often good management can be equated with good communication. An ongoing system of communication with administrators can really make a difference in solving problems.

Computerized Maintenance Management

A competent management company will offer a computerized management system. When evaluating a contractor, look for these features in their computerized maintenance system:

- Work order management;
- Calendarization of cleaning and maintenance tasks;
- Computerized random inspection system;
- Employee scheduling and daily time sheets;
- Preventive maintenance;
- Energy management;
- Inventory control; and
- Easy-to-read reports.

More importantly, the computerized system should be simple to learn so that it will help custodial and maintenance staff in organizing and planning.

Computers alone are not the answer. No matter how good the computerized maintenance program, it must be properly implemented to provide benefits. In a large school district it could take as much as a year for the district's staff to inventory equipment, classrooms, offices and other work areas, load this data onto the computer program, implement procedures and become proficient with a new computer-assisted system. This may not be the best use of a district's custodial and maintenance personnel. It is much more advantageous to the school district if the management company has a turn-key implementation plan where a start-up team performs these tasks.

Work Orders

One of the most important features of a computerized program is a good work order system. Work orders—requests for repair, cleaning and general upkeep—are the lifeblood of any effective cus-

todial maintenance system. In the past, when a teacher requested a desk drawer to be repaired, the request usually was made orally. Rarely did anyone report to the teacher when the work was completed.

When a management company uses a computerized work order system, the date of the teacher's request and her specific needs are easily logged onto the computer on a pre-printed form. With this type of documentation the maintenance or housekeeping department can trace any work order—when the request was made, if parts needed to be ordered, projected arrival date for parts, and completion. In addition, the teacher is sent a copy of the work order, showing the specific corrective actions taken.

Calendering Cleaning Tasks

Another feature that should be in place is calendarization of housekeeping tasks. Calendarization allows for regular, planned cycles for cleaning. Tasks such as stripping floors and washing walls can be carefully scheduled during off-peak times—nights, summer breaks and vacations. A formalized approach to scheduling housekeeping tasks means paying less overtime. Also, by using a computer calendariza-tion program, staff is less likely to let heavy work slide and are reminded when to strip a certain floor in a specific area.

Random Inspections

Certainly one of the biggest issues in choosing a management company is whether the school district's facilities will be cleaner. The management company should offer a quality assurance program designed to make sure plant operations, maintenance, grounds and custodial tasks are actually being done. Spaces should be inspected routinely to ensure that cleaning meets the district's expectations.

A policy of randomly checking spaces is an excellent way for maintaining quality control. By taking an inventory of all spaces in a school district, supervisors have the necessary information from which to work. A competent management company will collect all kinds of information—whether an area has a tile or wooden floor, a carpet, and whether there is a bathroom facility, etc.—and enter it into a computerized program. Then the computerized management system will generate random weekly inspection sheets.

Using this system, a manager routinely gets into every school room, closet and cafeteria. A supervisor might forget to keep tabs on some small office spaces. The computerized, random inspection system, however, does not let the supervisor forget.

After the random inspection is completed and it has been determined which tasks have been done satisfactorily or unsatisfactorily, the supervisor enters the results onto the computer. From the data, the supervisor can analyze the quality of work being done and plot the scores of randomly inventoried spaces. The company can then identify soft spots in its programs. If a task is being missed on a frequent basis, retraining may be necessary.

Training

Training custodial and maintenance employees can make all the difference in the quality of the services. Some contracting companies provide initial training. Others only provide on-the-job training, pushing the employee prematurely out into the job without any classroom instruction.

A complete training program will develop people. It will include instructional manuals, videos, initial training, follow-up training, specialized cleaning modules and a plan for ongoing job training.

To improve productivity it is essential to train employees to do the job correctly the first time and reinforce training through on-the-job supervision. Using these methods, school districts can avoid costly callbacks for the same work.

A good training program recognizes employee accomplishments. Check the management company's recognition program. For example, after successfully completing a level of training, does the company award an employee a "Certificate of Achievement"?

Opportunities for cross-training (learning a variety of job skills) is also critical to custodial and maintenance work. Maintenance work can be as varied as repairing a broken pencil sharpener to working on a complex air conditioner compressor. It is the contractor's job to train employees in a variety of skills. Some companies offer in-depth, self-instructional courses in technical areas—air conditioning, welding, circuits and pump maintenance.

Check to see if there is a sepa-

"Finally, does the company have hospitality training so that employees understand who their customers are and how they should be treated?"

"The management company should offer a quality assurance program designed to make sure plant operations, maintenance, grounds and custodial tasks are actually being done."

rate training program for managers. Also, if a team is not strong in some technical area, such as electricity, would the contracting company have the resources, and be willing, to send an electrician out for extra training?

Finally, does the company have hospitality training so that employees understand who their customers are and how they should be treated? Some management companies go one step further—sharing their hospitality training with the clients they serve. Check to see if the contracting company offers any other training such as sessions on self-esteem, motivation, time management and safety. These courses help employees further develop themselves. In the long-run, these courses create a more productive, safer and less-stressed labor force.

In certain areas of maintenance, like landscaping, it helps to have specialized training. For extensive grounds care, does the contractor have resources such as training manuals, videos and trained experts who support a lawn and shrub maintenance program? Is there a plan for fertilization and liming, weed and insect control, edging and trimming, as well as snow and ice removal?

The key in analyzing any company's training program is to examine whether the company is investing in its people and growing the talent they need.

Energy Conservation

Does the management company have a formal energy conservation program? Will they identify energy savings opportunities for the school district? Some management companies will do an energy audit to pinpoint areas of excessive energy use and identify opportunities for savings. Often, just by instituting a strict program and changing some operating procedures there can be a reduction in energy consumption in the 5-10 percent range.

Regulatory Management

A management company should be prepared to handle regulatory compliance for the school district. See if the company is experienced in practices and training programs to meet national uniform codes in building, electrical and plumbing. Can they make recommendations on fire safety, hazardous material disposal and disaster plans?

A good contractor will review the school district's past regulatory deficiencies. A meeting with local authorities will be scheduled to assure that the school district is meeting all local applicable codes and standards. Then the contractor will identify all deficiencies and make a plan for corrective action.

In areas where newly-passed regulations necessitate alterations to a facility—a change in ventilation requirements, for example—can the management company act as an "expert agent" for the school district to carry out these changes? There can be significant savings when the contracting company is capable of determining what alterations, if any, need to be done, and can then prepare a written plan, manage the alterations project, and take the project to sign-off by the regulatory agency. A full-service management company can eliminate expensive sub-contractor fees by doing this work itself.

"It is a good idea to select a management company that has a pro-active philosophy for identifying and monitoring agreed upon aesthetic areas."

Safety Performance

Safety is one of the greatest concerns of any school district—both for students and employees. Prospective management companies should be grilled on their work safety performance and how they teach safety to their employees.

It would be in the best interest of the school district to check if a management company has a work place safety program. Do not hesitate to ask for the management company's safety accomplishments. See if they have been able to minimize lost time due to employee injuries, limit workers' compensation costs, reduce injuries by visitors, and improve safety morale.

Total Quality Management

Among the buzzwords of the '90s is Total Quality Management (TQM). By learning to monitor, control and constantly improve systems, organizations are better able to provide customers what they want.

In selecting a private management company, it is fair to investigate how committed it is to quality. Is its quality program supported by top management? Does the corporation have a vision and set of values? Does it support the vision and values through what it actually does and through its leadership principles?

"Prospective management companies should be grilled on their work safety performance and how they teach safety to their employees."

Aesthetic Management

Managing the aesthetics of a school district is vital. It improves relations with the community, bolsters staff morale and makes students proud of their surroundings. As part of an agreement, the management company and school district must determine the correct school image to be delivered.

For example, proper exterior

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and interior illumination, wall appearance, floor appearance, landscaping and grounds care may be of particular importance in projecting a positive school image. It is a good idea to select a management company that has a proactive philosophy for identifying and monitoring agreed upon aesthetic areas. This area of management is one of the least expensive techniques available to enhance a district's image.

Budget Management and Cost Controls

Cutting to the bottom line, school administrators will want to quickly assess—how much will it cost? A better approach is to ask—how much will it save? A capable management company will offer management and cost controls as part of its contract budget. The company should be capable of controlling and forecasting all maintenance and custodial department expenditures. Areas of budgetary control which a management company should be able to monitor are salary and wages, utilities, purchases of services, supplies and equipment, and administrative costs.

Make certain the management company will provide an operating budget and will be able to back that up with timely budget analysis and reporting to assure costs are within the agreed upon budget.

Besides putting a cap on costs, a contractor may be able to help the school district with certain important capital improvements. This can be negotiated into the contract with the assurance the school district will work with the management company for a specified period of time in order to pay back the capitalization.

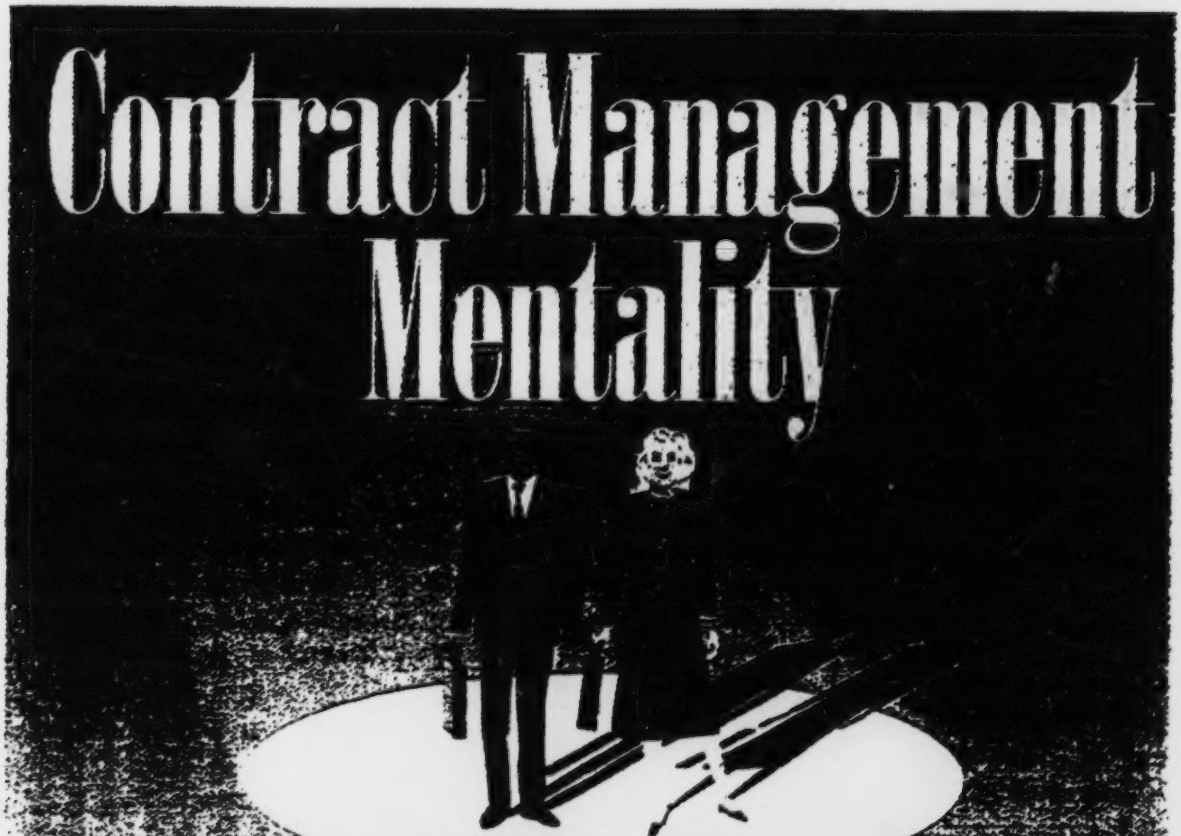
Tailoring Services

Custodial and facilities management services need to be tailored to each school district's needs. In general, however, proven, computerized systems for work orders, cyclical cleaning and routine preventive maintenance raise the quality of facilities management services. Also, bringing in the right piece of equipment to do a specific job, adequately training employees on how to use it, and hiring a specialist when necessary can benefit a school district in both the short- and long-term.

A management company that works closely with school business administrators in solving problems through a system of routine meetings means less headaches down the road. The results should be a better product—well-maintained equipment and cleaner, more aesthetically pleasing surroundings—at a substantial savings to the school district.□

Gregg Miller is the national vice president, sales, for Marriott School Services, Orange, CA.

Contract Management Mentality



Are YOU Ready for the Spotlight?

By Philip "Red" Whiddon

Contract management of all phases of school business is a reality. Are you ready for the scrutiny?

Has a school board member or superintendent ever suggested that your district look into contract management services so that money could be saved? Have you ever been asked to put your job description on the open market for criticism and remarks? Have you ever analyzed your organization and personnel as if you were a contract management firm? What if bid specifications were analyzed and the cost was less than your salary plus benefits? Do you have the ability to change your governmental mind-set to one which possibly could be more efficient or organized or may be radical in the eyes of the local board or superintendent?

If your district has reached the conclusion to bid contract management services, or improve in-house management, these questions, plus those listed in Figure 1, should be answered.

Deer Park's Experience

During the 1990-91 school year, drastic cuts in costs were enacted in the Deer Park Independent School District (TX). Because of reorganizations, retirements and resignations, an

FIGURE 1
Questions To Ask

Contract Management

Why is the district in the situation it is in?

What will a contract management company do differently than your in-house departments?

Is the administration not happy with an in-house management person and could this problem be corrected? What is the district's perception of its own people?

What are the financial states of the individual departments?

Will the board approve changes for a contract management company that it is not willing to do for its own in-house departments?

What will the organizational health of the district employees be if a contract management company is employed?

Once it is ascertained that a contract management company should possibly be employed, are apples being compared to apples?

Get a three-year price comparison to make sure the low bidder is not just trying to get in the door and then increase the price.

Will the district have the right to hire and fire the person assigned to the district as the contract management administrator?

Have all options been thoroughly investigated before a contract management company is employed?

How many years and in what areas have the contract management companies been successful? In what similar school districts? Is the district and the school board willing to interview and critique the management company's services in other districts from the customer's perspective?

Will the contract management company solve the problems in the long term?

Are the contract management companies really more effective?

In-house Management

Is the top administrator who is responsible for the departments really qualified?

What does the organizational chart look like? Too many supervisors? Not enough?

Are the employees properly supervised?

Do you have an efficient, effective work order tracking system? Is the work checked and parts accounted for?

Is your utilities consumption in line with similar districts?

Is there an effective energy management program?

Can your budget be justified?

Does the budget manager have control of his/her budget, i.e., energy, custodial or contract services?

Do the board and tax payers know how good or bad a program you have?

Does your district have a budget task force? Do you have input on district-wide decisions?

What could you recommend so that the district would not hire a contract management company? How long would it take to correct existing problems?

If you were the responsible administrator, could you bid out your job and be comfortable that you would still have a job?

issue was brought up to possibly contract the management of the maintenance, operations, construction over-site and energy management activities of the district. Since I was about to assume these duties (because my immediate supervisor was retiring), the possibility of the district hiring a contract management company was of great concern. There would be no need for both a contract management company and me.

At first I thought my future was in jeopardy. I talked with the superintendent and realized that all of us should be ready, at any time, to compare our job performance to an outside contract management service company. Unless each administrator is committed to improvement and change, they will not succeed in providing the best management of their respective district.

I prepared the following request for proposal based on current levels of service. The following specifications should assist you in the preparation of a similar bid. The local district boiler plate information is not supplied but the specific necessary information is.

Contract Proposals

In the 1990-91 school year the maintenance and operations departments were put out to bid for contract management services. The staffing in maintenance at that time was three administrators, two secretaries, one clerk and 42 hourly workers. Currently there are two administrators, one secretary, two clerks and 42 hourly workers. The total budget (including salaries, utilities, etc.) for the department is $7.5 million. In addition, the department oversees the work stemming from a $63 million construction bond issue.

Two of the five companies which bid, did not bid the contract management of the maintenance department. All contract management bids were for three years.

The companies bidding for the maintenance contract submitted bids that started as low as $100,812 for the first year and increased to as much as $127,128 by the third year. The cost did not include over $250,000 worth of additional equipment some felt would be necessary for improved facilities. The companies bidding for the operations contract submitted bids that started as low as $119,940 for the first year and increased to as much as $216,696 by the third year.

All of the contract management bids were for additional monies to the current budget. Under their bids, my position and salary would have been retained; the representative from the company would have been in addition to me, not in place of me. Furthermore, none of the bids guaranteed any savings to the district.

Needless to say, none of the bids were accepted. Although I did not get a large bag of additional money the next month, I did get my superintendent's respect and understanding of the value of my job in relation to outside contract management companies.

It is my belief that local district management and operations management is as effective as any outside management company if the availability of funds is the same. The current programs are not only efficient; they are cost effective. The good condition of Deer Park's buildings and the cleanliness and proper operation of even outdated equipment speaks well of the in-house department.

Be Prepared

Contract management of maintenance and operations is a growing trend. If you believe your in-house department can do as least as good of a job as an outside contractor, you need to be prepared to justify your position. Taking the following steps may help:

- Be prepared to justify your department at any time.
- Continually update your departmental information so that it is ready for press immediately.
- Take a proactive stand on new ideas and different approaches.
- Learn from the contract management companies. "Sales" is what makes things happen.
- Try and hire a competent consultant who will assist you in the education of the decision makers. Many times an opinion of an outside person is better received than an opinion from someone within an organization.
- Be honest with yourself and your departments. If improvements can be made—do it now. Do not wait until some contract management company looks over your shoulder and says, "Boy, I can really save the district lots of money!"

Conclusion

Many administrators would consider employing a contract management company rather than working out the problems with the existing staff. Why? In many cases it becomes a political issue connected to a new superintendent or school board.

As a director of maintenance and operations, you need to take a proactive stance on the issue of contract management. Make sure your school district takes an unbiased view of all services. Remind them that contract management is not free. There usually is a very high cost and no guarantee of savings when the same or better quality services are desired.

Most importantly, take a look at yourself. Are you efficient, organized and improving daily? Will your district's facilities assist the children in successfully reaching their educational potential? Without the children there is no district. Without the district there is no job. What is your job worth?❑

Philip "Red" Whiddon is the director of maintenance and operations for Deer Park ISD. He holds a degree in management development, Texas state HVACR license, Asbestos licenses, is a former contractor and has worked for a contract management company. He is currently chairman of the TASBO Maintenance and Operations Committee and has been a presenter and certification instructor at TASBO conferences.

Deer Park Independent School District
Request for Proposal

Contract Management Bid Specifications

Goal

The Deer Park Independent School District (District) desires to optimize educational excellence by continuing to provide the students, employees and patrons of the District with facilities, equipment and grounds that are safe, clean and well-maintained by using prudent business and operational practices.

Purpose

The District desires to receive bids from qualified bidders to manage one or more of the following services: Management of Plant Maintenance and Operations and Management of District Custodial Services. The selected bidders shall provide the District with all management personnel, technical support, training materials, equipment, computerized systems and effort necessary to perform these services at a quality level that is acceptable to the District.

Scope of Contract

The District will award contract(s) to bidder(s) to manage one or more of the services listed above. Those services not included in this contract will be managed by District personnel.

Specific Conditions and Requirements

Management of Plant Maintenance Department

The successful bidder will be responsible for managing this department; specific responsibilities will include, but not be limited to, the following tasks:

- Install a proven computerized plant maintenance work order tracking system having cost accounting functions. Install a proven computerized program for planning and scheduling plant maintenance activities.
- Supervise computerized scheduling of work for all maintenance personnel.
- Provide the school district with printouts of all data programs.
- The computer system, software and associated equipment will become the property of the district at the end of the contract.
- Respond to all maintenance needs and other requirements traditionally supervised by the maintenance department, to include asbestos management, hazard communication management and compliance with all state and federal laws pertaining to toxins, storm sewer, PCBs, and other hazardous waste.
- Perform inventory and assessment of capital equipment needs' life expectation.

For example, the principals in our district were very happy with the way our M&O department cared for the athletic fields. They were concerned that the contractor would not have the expertise to care for the fields properly. Therefore, we did not include maintenance of the athletic fields in the RFP.

This vague wording is to the district's advantage. It forces the contractor to inform the district if it plans to charge extra for a service, for instance, cleaning venetian blinds. It gives us the chance to haggle about the charge. If we don't like the charge, we can have our in-house staff take care of it. In any case, it prevents the contractor from doing the work and charging us for it later.

We did not have a computerized system at the time this RFP was written. We wanted to have school district personnel run the program and make clear that it belonged to the school district. This prevents the disaster of the contractor leaving two or three years down the road and taking all of the software knowledge and data with them.

- Supervise of all capital equipment installations included in regular budgets and projected bond expenditures ($700,000 per year).
- Establish budget control and quality control systems.
- Operate warehouse: maintain inventory, order and delivery of all warehouse materials and equipment.
- Supervise and manage all grounds keeping functions.
- Order all materials and supplies in accordance with district purchasing policies.
- Provide technical expertise to specify the most cost-effective solutions to plant maintenance problems as they arise.
- Supervise vendors, contractors and consultants whose products and services are secured through the campus physical plant budgets.
- Manage and direct the prudent use and maintenance of vehicles and other equipment assigned.
- Manage all personnel matters, except hiring and firing decision making, according to district procedures.
- Conduct monthly review meetings with school personnel.
- Make recommendations on facility improvement.
- Provide education and training programs.
- Conduct monthly safety training.

Management of Custodial Services Department

At the present time, the management of this department is being provided by school district officials. The district desires to select a person, persons or a company to provide professional management for this department. The employees in this department will remain on the district payroll, and the management personnel will be paid by the successful contractor. The successful contractor will be responsible for managing this department, specific responsibilities will include, but not be limited to, the following tasks:

- **Provide custodial supplies. The district will provide paper towels, toilet paper and other expendable paper products; and plastic waste paper liners. The district will provide all waxes, cleaners, brooms, mops, and other chemicals and materials necessary for the housekeeping program.**
- Provide technical expertise to specify the most cost-effective solutions to custodial services problems as they arise.
- Supervise vendors, contractors and consultants whose products and services are secured through the campus physical plant budgets.
- Order all materials and supplies in accordance with district purchasing policies.
- Manage and direct the prudent use and maintenance of vehicles and other equipment assigned.
- Manage all personnel matters, except hiring and firing decision making, according to district procedures.
- Conduct monthly review meetings with school personnel.
- Make recommendations on facility improvement.
- Maintain and monitor all fire, safety, health and other regulatory agency requirements relating to physical plant operations.
- Provide education and training programs.
- Establish budget and quality control systems.

This is a crucial point. Purchasing practices are where contractors make their profit by cutting the amount of product they use. They say they are buying and using 5 gallons of floor wax but they only put down 3 gallons. We felt we needed to have a way to monitor the quality and amount of the products they would be using which is why we specified that the contractor would have to comply with the district's current purchasing practices. We included a detailed list of these practices in the RFP—it was too long to include with this article. If we didn't ask them to use our purchasing practices and let the results speak for themselves, we would likely have gotten into a lot of finger pointing and subjective disagreements about the quality of the work. Contractors will argue that they can save a tremendous amount of money on supplies because they purchase in huge quantities. Our district is part of a large school district purchasing cooperative so we felt we are already getting low prices on our cleaning supplies.

As I mentioned in the article, I was asked to issue the RFP not because of any unhappiness with the quality of our work, but to find out if we could get the same quality of service for less money. We included this clause because we felt we had an outstanding group of employees. We wanted to protect our personnel from being let go by the contractor in favor of less expensive, less qualified workers. We felt that this would demoralize the whole department and jeopardize the quality of the M&O and custodial services.

As mentioned earlier, this is to ensure that the contractor follows the same practices that our in-house staff had been using successfully.

Bidding Instructions

Bids shall be submitted in the format described below. This material must be in the same sequence as below. Additional information may be submitted as an appendix to the data submitted by the contractors, but should not be inserted in the bid form. Only information specifically related to this type of project will be evaluated. Bids must present the following information:

Personnel & Fees (include on bid form)

The bidder agrees to provide a specific number of full-time, on-site management personnel for the monthly fee listed. The specific number of personnel and the fee must be provided on the bid form.

While we didn't have a particular reason for asking for seven projects, we felt that two or three was definitely not enough. We wanted their recent projects so we limited the examples to the last three years.

Specialized Experience (attach on separate pages)

Describe your firm's seven most recent representative projects giving the information requested below. (Minimum acceptable period of recent representative experience is three years.) Attach on separate pages.

- Client's name.
- Location.
- Brief description of services provided.
- Length of account tenure.
- Building area, number of site locations, size of staff supervised and student population.
- If performed in association with another firm, list specific areas of responsibility of your firm.
- Name, address and telephone of client representative contact.

Project Personnel (attach on separate pages)

- Management of Plant Maintenance and Operations (if bidding for this Service)
  - —Describe your project team organization and identify specific personnel to be assigned to this project.
  - —Identify any associates or outside consultants.
  - —Provide resumes of the personnel who will be directly involved in the project, i.e., actual people performing the work on the project, not the contractor's home office manager. Resumes shall indicate the following:
    - Education.
    - Number of years experience; number of years with present firm.
    - Specific related experience.
    - Availability of the person to work on the project.
    - **Identify the current and proposed project and the time commitments of this person.**

We wanted to be sure that the person assigned to our district was going to be there full time. We did not want the person to be splitting his/her time with another project.

- Management of Custodial Services (if bidding for this Service)
  - —Describe your project team organization and identify specific personnel to be assigned to this project.
  - —Identity any associates or outside consultants.
  - —Provide resumes of the personnel who will be directly involved in the project, i.e., actual people performing the work on the project, not the contractor's home office manager. Resumes shall indicate the following:

- Education.
- Number of years experience; number of years with present firm.
- Specific related experience.
- Availability of the person to work on the project.
- Identify the current and proposed project and time commitments of this person.

Program Concept and Structure (attach on separate pages)

- Proposed management concept.
- Proposed organizational structure.
- Previous history of success/failure with the proposed program.
- Plans and procedures for providing this service at a high-quality level within the district budget.

Cost Control (attach on separate pages)

- Management of Plant Maintenance and Operations (if bidding for this Service).
  - —Proposed plan for controlling costs on the project.
  - —Previous record on meeting budgets and estimating proposed costs.
  - —Cost control method used to determine the necessity of budget increases.
  - —Projected savings incurred from personnel changes/deletions, energy management, etc.
- Management of Custodial Services (if bidding for this Service)
  - —Proposed plan for controlling costs on the project.
  - —Previous record on meeting budgets and estimating proposed costs.
  - —Cost control method used to determine the necessity of budget increases.

Public School District Work Experience (attach on separate pages)

Minimum acceptable period is three years. Name and location of public school district, name of school district employee contact, size and relevance of previous projects to the work proposed.

Management Information About the Contractor (attach on separate pages)

- Number of clients, including size and location.
  - —Number of school districts.
  - —Number of colleges.
- Years in business using current name.
- Years in business using other names.
- Growth trends for last five years.
- Last three years' gross revenues.
- Include copies of: Insurance certificate(s) showing current levels of coverage. Your current annual report, including balance sheet, income statement and related financial statements.
- Training (attach on separate pages)
  - —Explain how your company will meet or exceed the requirements for employee training.

We wanted to find out how the contractor planned to interact with the school district and the steps it planned to take to implement that plan. We found that some wanted to report directly to the superintendent, some to the school board, others to the business manager.

We wanted to find out if they were trying something new with us or if they had done it successfully elsewhere (we didn't expect them to report on any failures).

We wanted to know if their plans involved purchasing a lot of equipment in order to accomplish the tasks outlined in the RFP. We also wanted to know if they were expecting to use the district's money, if they were going to pay for it and include the cost in the contract, or if they planned to pay for it and take the equipment with them when their contract ended. Sure enough, several contractors said they would have to buy additional trucks and other equipment.

While this may seem to repeat what we asked for under specialized experience, we wanted to hone in on just the education-related experience. Many firms contract with office buildings or strip retail centers and might have used those as their references under specialized experience. Even if some of the references are repeated, it gives us a chance to cross check them and make sure they are telling the same story.

We wanted to find out if the contractor was financially healthy or if it was a prime candidate to take our upfront money and run.

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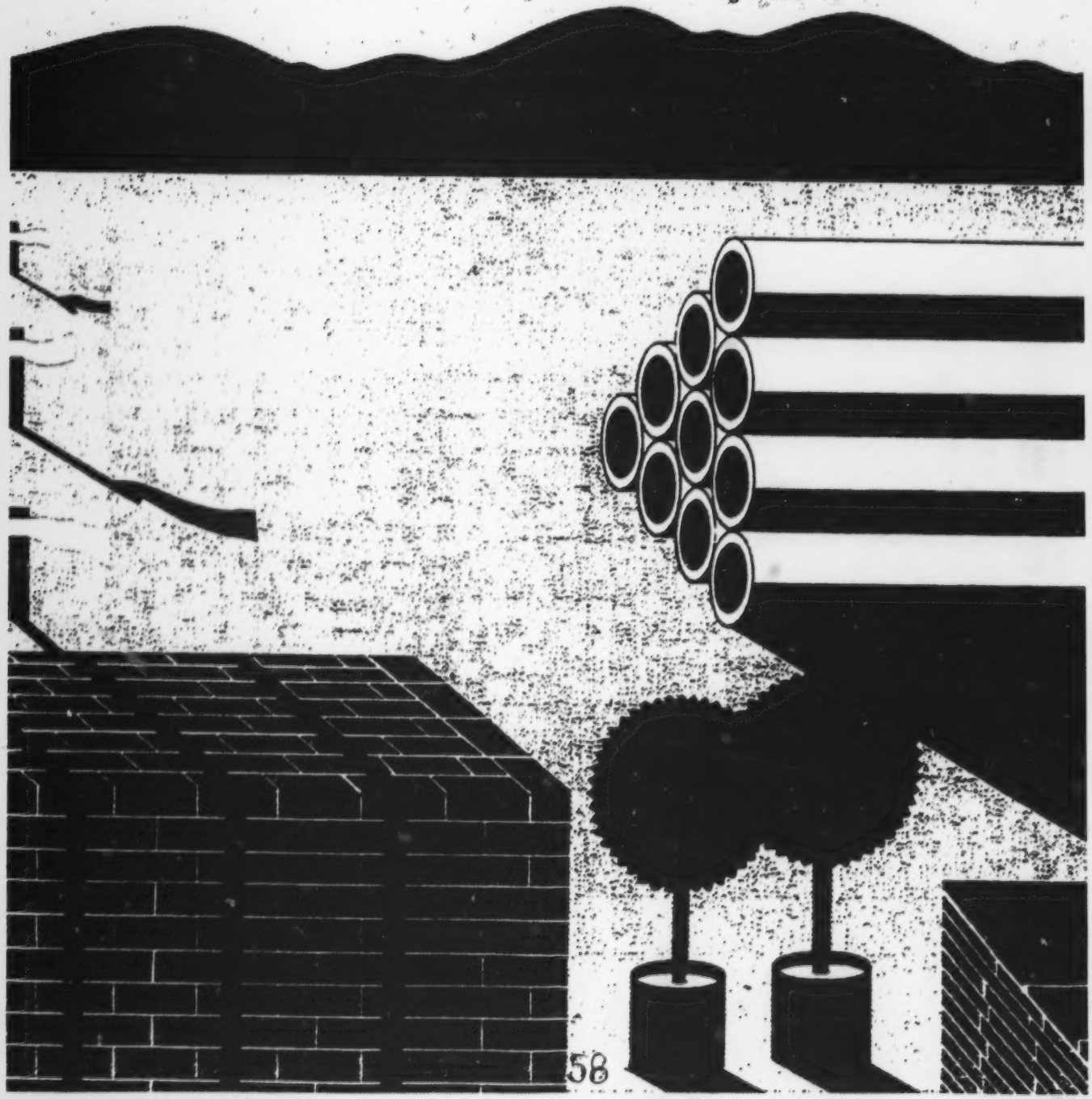
Energy Management

Monitoring Energy Consumption: The Energy Use Guide and Energy Use Index Program

By Dr. David S. Honeyman and Dr. R. Craig Wood



School business officials have a critical need for technical assistance and information on saving energy and money on school utility bills. A 1983 survey conducted by the American Association of School Administrators cited energy costs as one of the greatest contributors to superintendents' financial problems. A 1985-86 survey of the Kansas Association of School Business Officials revealed that a majority of the school business managers expressed a significant need for energy saving plans.

A Department of Energy report entitled "School Finance and Energy Through 2000," projects high energy costs throughout the foreseeable future. This report projects energy costs to approach $700 per student by the year 2000 and a national educational energy/utility cost in excess of $31 billion. The greatest future utility cost increase will be in natural gas, which is the energy source used by most educational facilities. These projections indicate an 80 percent increase in the cost of fuel by the year 2000. This could result in energy cost increases of almost five times the current expenditures. For example, during the 1983-1985 biennium, Kansas school districts alone spent a total amount of $56,297,976 for energy costs.

These increases represent a fiscal burden on an already overstressed educational system as well as taxpayers. Effective conservation measures for schools are the only possibility for reducing this financial burden, while saving natural resources. Generally, it has been noted that educational facilities are relatively inefficient users of energy. In the majority of cases, it is estimated that energy consumption and costs can be reduced by up to 30 percent with the use of simple conservation measures and constant awareness and monitoring of use.

Such conservation measures require technical assistance and information for district business officials. According to a Michigan Association of School Business Officials publication on energy conservation, lack of training and expertise in energy conservation measures is a major concern when conserving energy. Building principals must be made aware of the energy consumption of their building and how this compares with similar school building averages. They must be informed of common energy waste and strategies for conservation. Small and rural districts are especially in need of assistance because they lack access to funds and specialized facility management personnel that can be utilized in energy conservation programs.

Energy Use Guide and Energy Use Index

In order to conserve energy, school business officials need raw data to evaluate the potential savings as well as costs of energy improvement projects. But even before conservation projects can be planned, how does a school administrator know if a school building is using too much energy?

Numerous experiences by the authors and others have indicated that detailed monitoring of energy consumption at the building level produces the most effective conservation practices in small school districts. Principals who are comparing the efficiency of their operation with that of other principals are in the best position to recommend changes and improvement that will result in energy conservation. However, comparative information must be available for building administrators to use.

The Energy Use Guide can provide such information. The guide (see Chart 1) is a modification of the standard used in the industry and is appropriate for monitoring the energy consumption for each building and any appurtenant structure operated by the school district.

Data are collected monthly and annual figures calculated. This mathematical representation of on-going energy consumption will allow the building principal to monitor the basic energy consumption for the building. This information can subsequently be used to determine the success or failure of conservation programs.

It has been noted that educational facilities are relatively inefficient users of energy. In the majority of cases, it is estimated that energy consumption and costs can be reduced by up to 30 percent with the use of simple conservation measures and constant awareness and monitoring of use.

CHART 1

District Building Energy Use Guide

Name of Building _____

Year Built _____ Grades Housed _____

Capacity _____

Current Consumption		Conversion Functions
# BTUs	= KWH (Kilowatt Hour)	x 3413
	= MCF (Million Cubic Feet)	x 1,030,000
	= Gal (#2 Heating Oil)	x 138,690
	= Gal (Liquid Petroleum Gas)	x 95,475

	Electricity KWH BTU Cost	Gas MCF BTU Cost	Oil Gal BTU Cost	Totals BTU Cost
January				
February				
March				
April				
May				
June				
July				
August				
September				
October				
November				
December				

YEAR-END TOTALS

Building - Gross Sq. Ft. _____
Appurtances - Gross Sq. Ft. _____
Number of Pupils FTE _____
Sq. Ft. Heated/Cooled by Gas _____
Sq. Ft. Heated/Cooled by Electricity _____
Sq. Ft. Heated/Cooled by Oil _____

Consumption (BTU) per sq. ft. per year:
Gas _____
Electricity _____
Oil _____

Consumption (BTU) per pupil per year:
Gas _____
Electricity _____
Oil _____

Cost per sq. ft. per year:
Gas _____
Electricity _____
Oil _____

Cost per pupil per year:
Gas _____
Electricity _____
Oil _____

The computed values for annual consumption per square foot and the annual consumption per pupil can be used to calculate Energy Use Indices for each building based on a comparison with the average consumption for the entire school district. These indices are calculated as follows:

The Per Pupil Index:
Index (p) = *Building Consumption* (p) - *District Mean Consumption* (p) [(p) = Standard Deviation]

The Per Square Foot Index:
Index (sf) = *Building Consumption* (sf) - *District Mean Consumption* (sf) [(sf) = Standard Deviation]

Both the per pupil and the square foot calculations should be used. Changes in student enrollment from one year to another would not be reflected in the square foot calculation. Although it is important to have the index based on square footage for the comparison, it has been noted that the per-pupil index gives a more valid indication of the effects of school population changes on the level of energy consumption for a building. A simple Lotus Spreadsheet is available to assist with these calculations.

Each calculation results in a standard score (a "Z score") indicative of the deviation of that building's measured consumption from the mean consumption calculated for the entire district. These indices can be ranked and used for comparative purposes within the district.

The utility of the Energy Use Indices is limited only by the imagination of school personnel and level of need of the school district. The indices can be used to establish cut-off scores that can be used as indicators of low energy consumption or excessive consumption for buildings within the district. During conservation efforts, annual changes in the consumption can be monitored such that school business officials have a simple mechanism for evaluating the success of their efforts. Large and unexplained fluctuations in the computed values of these indices may point to the need for professional assistance and the performance of a comprehensive energy audit of that facility.

In conclusion it must be noted that energy conservation is still vitally necessary in order to engage in the efficient use of fiscal resources. As school buildings continue to age and levels of deferred maintenance are at an all time high, the need to monitor energy consumption will continue. The energy "crisis" has not disappeared. Rather, it is in temporary abeyance.□

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The Three R's of Utility Savings

Rate Reduction, Rebates and Retrofit

By Raymond V. Petniunas

Lowering school utility costs by participating in utility rate cases has been gaining momentum in Pennsylvania and elsewhere. School districts armed with accurate, convincing usage data and responsible rationale have reaped substantial dollar savings by reducing their electric rates during rate case proceedings before state regulatory commissions.

The reason utilities require rate increases is that they continue to establish new peaks in meeting growing energy demands and thus require new expensive generation sources and transmission plants. The cost of these facilities are eventually recovered through rate increases approved by the state utility commissions.

State commissions have final authority to approve utility rates to be charged consumers. Therefore, commissioners and their staff review utility rate increase requests in detail. They ascertain the amount of revenue a utility needs, the percentage increase over prior rates the utility will be permitted to recover, and the method of distributing any increases to consumers, including schools. Over allocation of revenues to certain rate schedules and unsuitable class rate designs can affect schools adversely.

For this reason, some school districts are pursuing rate modifications through rate case participation, while others are in the process of establishing energy rate reduction consortiums. However, to obtain maximum energy savings, schools should integrate rate case participation (rate reduction) with conservation and load management efforts (rebates), and retrofit operations, to obtain a total energy cost reduction package. The "three R's" process is an effective way to increase electricity energy savings for school districts.

Rate Reduction

Understanding your electricity bill and rate schedule and adjusting your usage pattern to it is part of an efficient load management and conservation program. Many schools have already shifted their usage patterns to take advantage of lower rates.

However, many schools can effectively influence the development of their rate schedules to reduce their rates. They can then adjust their usage patterns to conform to the new, lower rates. This process of influencing and thus reducing your rates through the rate case process is rate reduction.

Usually schools are on the best commercial rate available to them. This is a direct result of utilities serving their customers on an average rate such as residential, commercial or industrial. These rates serve a wide variety of customers, those who contribute to the new summer plant requirements and those that do not. The net effect is that some off-peak customers like schools may be paying more for their electricity than they should. If special rate provisions were designed for schools reflecting their operations, savings could be considerable.

It is also important to understand that any savings achieved through the rate case process are achieved year after year into perpetuity based on a one-time rate reduction effort. For instance, if rates are reduced from 10¢/kwh to 6¢/kwh, 4¢/kwh is saved every year, forever. If a utility asks for a new rate increase, schools obtain additional savings by avoiding future increases on the reduced 4¢/kwh. By obtaining a reduced schools' rate, savings continue to compound to school buildings with no additional effort on their part.

To get the full electricity dollar savings for schools, the total systems concept of rate reduction is most effective. This also would include rebates from utilities for energy load management/conservation and retrofit operations, which will be discussed later.

Typical Rate Case Process

As mentioned earlier, electric utilities continue to add new generation sources and transmission plants to meet customer demands. These new plants along with more expensive operating and mainte-

nance costs, new federal regulations, and new taxes, continue to exert pressure for utilities to file for rate increases to meet their cost of service.

To accomplish this, utilities conduct numerous studies and prepare testimony to justify why their rates should be increased, and how the class rates should be designed. These multi-volume case materials are then filed with the state public utility commission for review, rate determination, and a final order reflecting new and higher rates.

As soon as the utility files its case, many intervenors and other opposition groups petition the commission to be part of the rate case proceeding. They then prepare their own data, information, and testimony, either rejecting the increase, or requesting that more revenues be allocated to other classes of customers and not to them, i.e. to those customers that are not objecting to the rate increase.

The residential class is usually represented by a consumer or public advocate requesting lower rates. The industrial customers are represented by lawyers and expert consultants presenting testimony on why their clients' rates should be lower. Commissions listen to participating parties and respond to their concerns. As a result, public advocates and industrial intervenors have been very successful in reducing their rates during rate case procedures thereby saving the people and organizations they represent millions of dollars.

The commercial customers normally do not participate in rate cases. Therefore, commercial customers receive higher increases than the other two groups of customers. Unfortunately, schools are commercial customers. As such, they normally receive a greater share of the rate increases in the final orders issued by commissions.

Schools must participate in these rate proceedings in order to enter their efficient operations or past overcharges into evidence for consideration in determining lower rates.

After reviewing all the utility, intervenor, and commission evidence in the case, the commission establishes the new higher revenue level the utility needs to continue operations. The commission decrees how this added revenue is to be allocated to customer classes; this will determine what added rate increases schools will have to endure.

The way the commission distributes the cost to different classes of customers (including school systems) can vary. Commissions have used countless methods, nonetheless, some methods for allocating costs to classes of customers could hurt schools. If the allocation is detrimental, schools should certainly participate in the rate reduction process to obtain a more favorable allocation method.

The way the rates are designed within the classes of customers can also negatively affect school districts. If rates are not designed from a school's perspective, utility costs can increase two or three times higher for schools than for other customers in the same rate class. Therefore, it is to the school districts' advantage to participate in rate case proceedings and to analyze the various ways revenues are distributed to them.

> *"Unfortunately, schools are commercial customers. As such, they normally receive a greater share of the rate increases in the final orders issued by commissions."*

> *"If rates are not designed from a school's perspective, utility costs can increase two or three times higher for schools than for other customers in the same rate class."*

Total Methods of Energy Savings—The "Three R"s

The rate reduction process is just one of the "three R's" that are key to effectively reducing electricity costs. The other R's are retrofit operations and rebates.

Retrofit Operations / Conservation

Replacing energy inefficient equipment and managing energy usage more carefully has been very successful in saving school districts countless dollars in electricity costs. These operations include installing new and more efficient air conditioning systems (HVAC), lighting systems, motors, and insulation, and undertaking effective demand side management programs for maximum conservation.

However, as a result of how utilities calculate customer rates, *retrofit operations increase consumer rates in the short run*. As unfortunate as this may seem, it is a fact. To obtain the maximum electricity savings in the long run, retrofit operations should be combined with rate reductions and rebates. These latter two methods can and do produce significant dollar savings on electric bills, since these savings accumulate year after year into perpetuity.

Rebates

Rebates are another effective way to reduce electricity bills. Many utilities now sponsor programs that pay cash to customers that adjust their usage operations, such as reducing peak loads, to benefit the utility. However, many customers are unaware of these

programs or how they may encourage their utilities to establish rebates. Many rebate programs have been implemented through the rate making or court processes. This is another reason school systems should participate in the utility rate setting process.

As a result of these energy saving procedures, some school systems have been very successful in saving electricity energy dollars. Our firm is presently involved in Western Pennsylvania in reducing rates for school districts served by a Pennsylvania electric company. The following reflects our efforts toward establishing an electricity consortium to influence the rate case process and how we will be participating in a future rate case to save the Pennsylvania Energy Consortium electricity dollars.

Pennsylvania Energy Consortium

School districts served by a Pennsylvania electric company formed the Pennsylvania Electricity Consortium (PEC) and hired Utility Resource Consulting Inc. (URC) to represent them in an upcoming rate case. The PEC encompasses over 60 school districts (360 school buildings) and approximately $10 million in annual electricity bills. There are nine intermediate units presently participating in the Consortium. Unfortunately, not all schools within these intermediate units are participating.

Presently the PEC is finalizing the billing data of the participating schools for accuracy and appropriateness. According to PEC Chairman Tom Brink of IU #6, Valley Grove School District, in Franklin, PA, "This historical bill evaluation has saved PEC approximately $250,000 through the spring of 1993. In addition, these modifications will be carried over to future years, and thus the savings will accrue annually, into perpetuity."

The finalized data will be used in the upcoming Pennsylvania utility rate case. The majority of data compilation ($6 million) encompassed the standard General Service-Secondary Rate Schedule. Presently, the Consortium will not pursue seasonal time-of-use rates for this group of customers. According to Tom Brink, "Depending on utility system functions and school load characteristics, seasonal time-of-use rates may not always benefit school systems. They could be very favorable if implemented properly. If not, they can raise your rates." The Consortium expects the utility to file a rate case either this year or next.

Future Consortium Goals

In the analysis of historical bills, URC found new conventions for billing and potential load modifications for additional savings. According to Brink, "Schools can save additional dollars by understanding the rates and reacting to them. One such provision offered by the utility is the Minimum Waive Provision. Many schools can benefit from this provision just by reducing demand by a minimal amount [often 10 kw or less.] This can save them up to $3,000 per month on their summer bills. Schools can help trigger this revenue saving mechanism by modifying their summer usage. Many school buildings are presently unaware of this procedure."

The Consortium is also discussing future demand side management (DSM) programs with the utility which could save the PEC schools an *additional* 10-20 percent on their $10 million electricity bills. The PEC plans to include only those schools in this program that are participating in the rate case. "Since all schools are not participating in the rate case, it would be unfair to the rate case participants to allow any school district to benefit from the DSM program," according to Brink. The Pennsylvania utility is in favor of this program, and has given its endorsement to its development.

According to Brink, "The rate case and future savings, which can be substantial, will transfer a significant amount of dollars to educating our kids. We look forward to these savings to buy new books, teaching materials, new technology and other educational materials."

Summary

School districts can save considerable electricity dollars by participating in utility rate case procedures before regulatory bodies (Rate Reduction). The Western Pennsylvania Electricity Consortium (PEC), in reviewing electricity bills for rate case participation, has already saved its member school districts $250,000. Many of these costs will be saved every year because utility costs are recovered annually.

The Consortium has also identified a rate mechanism that it plans to expand to save additional dollars for the schools. Presently, only a handful of schools have been able to save up to $3,000 per month per building during the summer billing months. In fact, many schools are unaware of how to modify their usage to trigger the procedure. The Consortium plans to expand this program so the majority of schools will be eligible for the mechanism.

The Consortium is also pursuing demand side management programs in accruing additional potential savings of 10 to 20 percent. The "three R's" is a practice which has certainly been gaining momentum in western Pennsylvania. It is a practice that is also gaining national recognition.□

Raymond V. Petniunas is the managing principal of the Alexandria, VA consulting firm Utility Resource Consulting Inc. (URC). The firm participates in rate case and other regulatory proceedings before State Utility Commissions in establishing electricity revenue savings. For more information about this article, please contact URC Inc. at 703/379-6148, or Tom Brink at Valley Grove School District at 814/437-3626.

When a Picture is Worth a Thousand Dollars

By Timothy J. Shrom

We have all heard that a picture is worth a thousand words. In our case the pictures used are worth thousands of dollars. Each month our electric bill includes a chart of our electric use plotted daily over the billing cycle. The charts are created by demand pulse meters installed in our buildings. It is amazing how special events in the schools involving stage use, gymnasiums, class schedules, cafeteria equipment and more, directly correlate to the plotted chart. It is an extremely valuable tool for managing energy usage.

From November 1989 to April 1990, the Solanco School District had the opportunity to participate in Pennsylvania's Institutional Energy Efficiency Partnership Project. The program was sponsored by the Commonwealth, The Pennsylvania Energy Office and the U.S. Department of Energy. A series of hands-on workshops covered the financial and technical sides of energy management. Installing demand meters and analyzing the charts they produce was one of the important practices Solanco has implemented from data presented in that program.

Getting Started

Installation costs for demand pulse meters are low, but, as always with energy management, getting the full benefit from the devices takes time and administrative commitment. Your local power company representative should be your first contact; he/she should be able to equip your building with a pulse or watt meter. It does not matter what the device is called as long as it is capable of producing the plotted chart (Figure 1). In our case the cost was under $750 per building. The chart will immediately begin to produce valuable information about each building's electrical characteristics that will help target energy problems and costs. It is important to note that you do not need expensive computers or controllers to get to this point.

With this information in hand, you will not only know how many kilowatt hours (KWH) each building used, but you will also see abnormalities of use on a daily basis. Demand (KW) readings for the billing cycle are recorded daily, and you will be able to pinpoint on which day and at what time the building's demand reached its peak. An average peak demand time for that building becomes apparent. Most importantly, an investigation can begin to ascertain what is going on in that particular building and why (Figure 2).

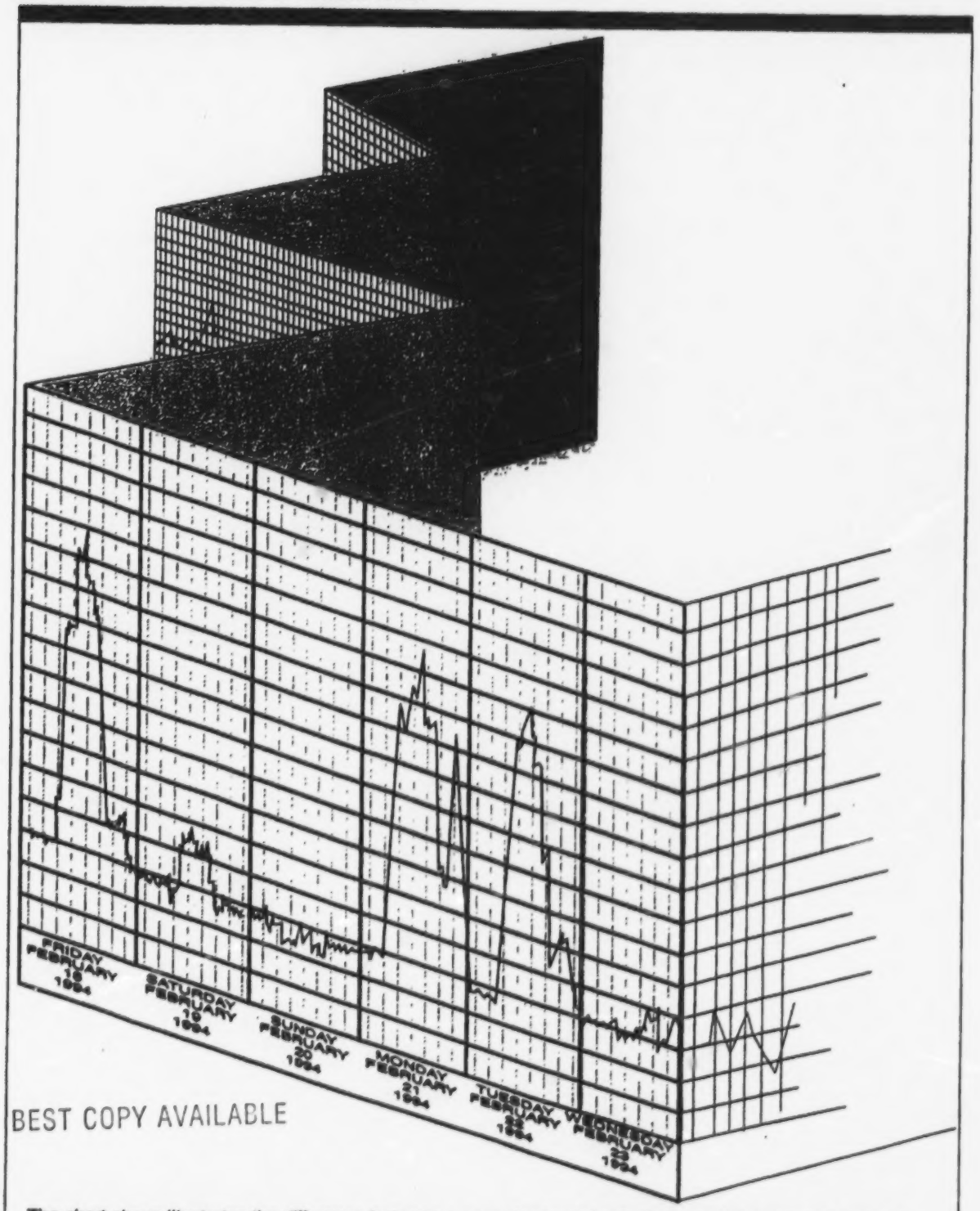
Goal Setting

Since demand (KW) is a significant portion of our district's electric bill in terms of dollars charged, Solanco targeted demand as a first priority (Figure 3). Our second priority was communicating information to district staff. Through a cooperative effort, charted data was used to lower peak demand via automated controllers as well as manual adjustments. For those of you who do not have energy management controllers or computers, this program can still work for you. An informed staff at any school can make many manual adjustments that add up to significant energy savings.

If you can follow through by showing each building's staff "pictures" and data showing the results of their efforts, ownership of the program will become widespread. The pictorial information makes it easy for everyone to see cause and effect relationships.

Cafeteria workers can see the effects of their equipment being turned on. They can be shown how turning on ovens in staggered time intervals can save dollars. Custodians can see the value of running buildings in the unoccupied mode whenever possible. Principals can see the difference made by not scheduling "heavy electric use" classes during heavy peak demand time. Maintenance workers (or

FIGURE 1
Plotted Charts from the Pulse Demand Meter


FRIDAY FEBRUARY 18 1994
SATURDAY FEBRUARY 19 1994
SUNDAY FEBRUARY 20 1994
MONDAY FEBRUARY 21 1994
TUESDAY FEBRUARY 22 1994
WEDNESDAY FEBRUARY 23 1994

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The chart above illustrates the difference between a normal school day in the occupied mode and a day in the unoccupied mode. Notice several weekdays when the school was closed due to snow and ice this past winter. The little blips on Saturdays are athletic and building use activities.

FIGURE 2
Questions to Ask

Some typical questions we asked ourselves and building staff as we looked at the plotted charts.

Why does a particular day always appear to be the day demand is "blown"?

What happened the day demand was "blown"? Were there weather changes? Schedule changes? Building use? Large assemblies? What was the lunch menu? If we do know what probably caused the "problem," what can we do to prevent it from happening again?

What is the average peak demand time? What occurs at that time period? Are "heavy electric use" classes scheduled over that time frame? Does the staff know when this time period occurs?

What is the morning routine of the building custodian(s)? When is equipment turned on? When are lights turned on/off? Does the building custodian understand and know how to place the building in the unoccupied mode?

During peak demand what equipment can we shut off?

During peak demand what can't we shut off?

In many cases, we found we could cooperatively find ways to make technical or behavioral adjustments that saved energy and still accomplished the task at hand.

hired contractors) can see how testing motors or other electrical equipment during peak demand can cost the district hundreds of dollars for a single fifteen minute job.

Implementation

As mentioned earlier, Solanco chose to target demand through the use of automated controllers. In our case, the controllers were already in the buildings and paid for by an earlier energy program. However, the controllers were under-utilized even though they had demand shedding capabilities.

The control devices (Honeywell W-7000's) are now tied into the pulse meters and are programmed to a predetermined level of demand (the target level). As the controllers sense demand reaching the preset level, they automatically shut down (shed) pieces of equipment or zones as designated by our staff. For example, one of our buildings with six zones is restricted to run only five at any one time above a certain level of demand. On a rotational basis, one zone is off for seven to eight minutes before being turned on as another is turned off.

Before implementing this type of "load shedding," we explained the procedure to the staff so no one would get excited when fan units in a room shut off for a little while. Comfort levels in the building were maintained with staff input as we "fine tuned" the program.

In addition to using the pulse meters, we knew we had to communicate with school personnel in order to reach our goal of reducing energy costs. The energy usage chart was sent directly to the principal each month. We took the time to meet with support staff members and explain what we were trying to do and why. In many cases, the principals as well as the support staff had no idea of the size of our electric bills.

FIGURE 3
Role of Demand in Electric Bill

	1/10/92-2/10/92 Total Demand = 649 KW	*1/10/93-2/10/93 Total Demand = 444 KW*
Demand Charges		
$7/KW for first 125KW of demand	$875	$875
$4.65/KW for all additional KW	$2,436.60 (649 – 125 x 4.65)	$1,483.35 (444 – 125 x 4.65)
Total demand cost	$3,311.80	$2,358.35
Savings		$953.45
Kilowatt Hour Charges		
$.0570 for first 150KWH for each KW of demand	$5,548.95 (150 x 649 x .0570)	$3,795.20 (150 x 444 x .0570)

Results

We chose an all-electric middle school (enrollment 450) to pilot the program. Average demand was reduced by nearly 16 percent in the first year of the program even though heating degree data for our region showed an increase of nearly 8 percent from the prior year. This translated into savings of a little more than $7,500 (or cost avoidance) in that same year; that more than paid for the new meter. It did not take us long to install pulse meters into other buildings.

That was two years ago, and we now have six schools on the "picture" program. Four of those are load shedding through controllers. Three other district buildings still receive monthly information even though we do not have pulse meters installed. All schools receive a monthly statement showing costs and electric usage for the prior and current months as well as the same period from last year.

In addition to the demand savings, we also had a reduction in kilowatt hours (KWH). It should be noted that KWH reductions do not necessarily follow demand reductions. Load shedding programs often run equipment longer and/or more often as you attempt to avoid running a lot of equipment at the same time. We attribute most of the KWH savings to the communication aspect of the program. All of us are better informed, and, whether you call it behavioral adjustments or manual adjustments, the program has worked well for us.

Programs such as the one related here can become a welcome part of your energy management mix. Unfortunately, energy management is often relegated to the back burner in school districts. To be successful, it needs to be managed with the same intensity we manage other aspects of school business. In fact, energy programs do not have to be new or fancy or complicated; however, they do need leadership, direction and an attitude of continuous improvement.❑

Timothy J. Shrom has served as the business manager at Solanco School District since 1982. He is also a Pennsylvania Association of School Business Officials (PASBO) Director and serves on PASBO's Facilities Management Committee.

Lighting Management
A Bright Idea for Cutting Costs

By Norma Frank, CLMC

As American corporations face more intense global competition, cutting costs and maximizing human productivity will be key strategies in surviving — and thriving — in tomorrow's business arena. Schools are facing a similar challenge, faced with declining revenue from reduced federal, state and local aid, and with greater demands to meet the needs of an increasingly diverse student population. Today's schools can produce better students for tomorrow — on a leaner budget — by following the lead of corporations who strategically manage their lighting systems.

Simply put, lighting management is the practice of strategically managing a lighting system to provide the greatest energy, time and financial savings while increasing occupant productivity and satisfaction with the internal environment. Lighting management seeks to minimize the three major costs of lighting your schools — electricity, replacement products and labor — while providing the light you need to effectively educate students.

Energy Conservation Possibilities

The typical classroom is lit by rectangular fluorescent lighting fixtures. Behind the plastic lens, each fixture commonly houses four lamps — literally, the cylindrical glass tubes — powered by two standard magnetic ballasts, which start up and power the lamps. A series of these fixtures is connected to a light switch. Operating these fixtures, along with the parking lot lights and incandescent light bulbs, can cost the school administration nearly half its electric bill. Just as the old luxury cars became known as "gas guzzlers," these obsolete systems are "electricity guzzlers."

Now consider this fact. According to the Building Owners and Managers Association (BOMA), some 90 percent of the cost of running your lighting system is electricity, with the other 10 percent allocated to maintenance and replacement products. Since the lion's share goes to electricity, it makes sense to commit a one-time investment in labor and product to dramatically — and permanently — reduce energy cost.

In the years following the Energy Crisis of 1979, energy-efficient lighting products appeared on the market which produce more light for less energy. Most of these products are simply improved versions of old ones, while some are innovations.

Let's go back to the typical rectangular fluorescent lighting fixture. The traditional 40-watt lamps can now be replaced by 34-watt or 32-watt lamps. The ballasts which supply power to these lamps can be replaced by energy-efficient magnetic, hybrid or electronic ballasts for increased energy savings. Electronic ballasts not only provide the highest energy savings possible from ballast replacement, but they can also reduce the hum and flicker associated with fluorescent lighting. Replacing a lamp-ballast system with an energy-efficient system described here can reduce energy consumption by up to half, with only minimal loss in light output.

One type of new ballast operates with a control, acting as a dimming system. This system takes full advantage of the classroom's cheapest source of light — sunlight coming through windows. The dimming system reads the amount of light currently in the room and adjusts the lighting system's light output accordingly, producing more light when clouds cover the sun, when the blinds are closed, or at night — and less light when the sun is shining brightly through the windows.

In exit signs, bathrooms, desk lamps, work lights, storage rooms and stairwells, incandescent light bulbs can be easily replaced by compact fluorescent lamps. The compact fluorescent takes the concept of the fluorescent system and miniaturizes it so that a small ballast and lamp can screw into an incandescent socket. This replacement increases the time between bulb replacements by a factor of 10 — reducing your replacement labor cost — while saving up to 80

percent in energy cost.

The standard light switch can be replaced by an occupancy sensor. Occupancy sensors turn the lights on when a student or teacher enters the room, then turns the lights off when the room is unoccupied. Most schools close at 2:45 p.m., although reduced activity continues until 6:00 p.m., or even later if there are school play rehearsals, scholastic achievement test courses or maintenance activities. As most people tend to forget to turn off the lights on their way out the door, many rooms go on being lit between 2:45 p.m. and 6:00 p.m., wasting energy. The occupancy sensor can provide high energy savings by simply turning off the lights in every room that's unoccupied.

Real Savings

Many other products are available that can help you slash energy costs with little or no decrease — or with an increase — in light output. Let's put these products into perspective with an example:

Suppose your school is lit by 1,000 fluorescent fixtures, each housing four fluorescent lamps powered by two standard magnetic ballasts. According to the American National Standards Institute (ANSI), each fixture consumes 192 watts of electricity. We install two T8 lamps powered by a single electronic ballast, a combination which consumes only 98 watts. We've saved 94 watts, cutting electricity consumption by nearly half with a modest drop in light output.

How does this translate into cold cash?

Your school's lighting system operates from 7:00 a.m. to 6:00 p.m. or even longer (say, 12 hours), 5 days per week. If you pay 8 cents per kilowatt-hour of electricity, one fixture in your old system cost you $47.92 per year to operate — $47,923.20 for the entire system of 1,000 fixtures. After we upgraded the system, each fixture cost only $24.46 to operate — $24,460.80 for the entire system.

After the upgrade, you saved $423.46 per fixture — $23,462.40 for the entire system.

Depending on the cost of the ballasts, lamps and labor, you can expect to see this state-of-the-art lighting system pay for itself in 2 to 3 years, and give you a profitable 5-year cash flow (5 years being the average time before large-scale lamp replacement is needed). If this system of 1,000 fixtures, for example, paid for itself in 3 years (a 33 percent return on investment), your school would earn $46,924.80 for its investment.

Demand Side Management

You can shorten payback and increase return on investment even more if your electric utility offers a demand side management (DSM) program. As energy demand continues to rise, many utilities cannot meet it without building new power plants — an expensive option both to the utility's customers and to the environment. With these supply-side hassles, many utilities are actually finding it cheaper to pay customers to upgrade their building systems — including lighting — to energy-efficient systems. Currently, over 1,300 programs are available with more than 13 million customers participating. They are most heavily concentrated in California, New Jersey, Pennsylvania and New England.

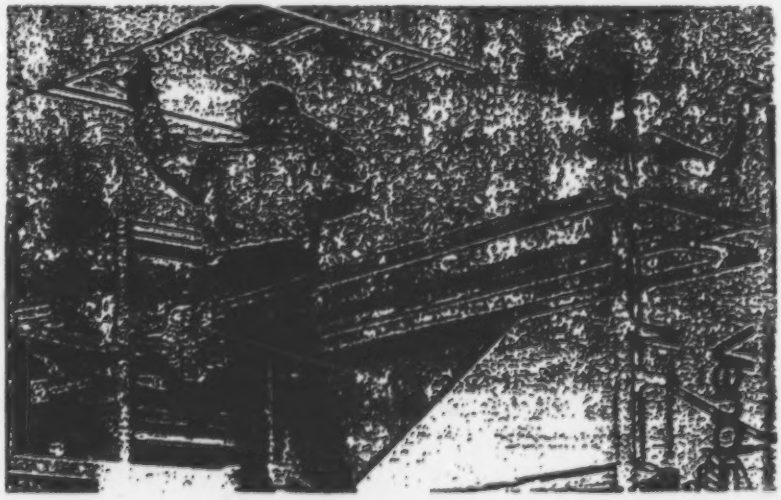
DSM programs can take many forms, the most attractive of which is the rebate. Rebates can be based on total energy reduction or based on individual products such as electronic ballasts. In either case, if you tap into one, you could reduce payback significantly by forming a partnership with your utility.

After your upgrade, the system must be maintained to protect your investment. Even if you don't upgrade, you should maintain your system to minimize replacement product and labor costs while guaranteeing that your students receive the right amount of light that you pay for and that they need to effectively learn.

Lighting Maintenance

Let's go back to our rectangular lighting fixture. The lamps inside produce light — that's called light output. The light then reaches the space where your faculty and students need it — that's called light level. In an ideal situation, the lamps would produce 100 percent of the light they're supposed to for their entire life, and all of this light output would fall in the right amount onto the desks and chalkboards where they're needed.

Unfortunately, a number of factors destroy this ideal situation. First, lamps age. As they do, their light output goes down (most noticeably after about 70 percent of its expected life). This doesn't mean, however, that the lamps' energy consumption goes down proportionately — no, you continue to pay the same cost for less light. Maximizing the effec-



Group relamping is the backbone of any lighting management program.

tiveness of your lighting system calls for a maintenance strategy that will eliminate this electricity waste.

The second problem is dirt and dust accumulation. No matter how good your housekeeping is, every building gets dirt and dust in the air. Because lighting systems produce heat, they attract some of it into the fixture. Unless the fixture is cleaned regularly, this dust continues to accumulate on the plastic lens and inside the fixture, including the lamps themselves. As a result, the dust absorbs a portion of the light attempting to leave the fixture causing light level to drop by as much as 25 to 50 percent.

Most older lighting systems were designed to account for age and dirt depreciation. This means that even with dirt, dust and age reducing the lighting system's effectiveness, students still received enough light. Again, the problem with this is poor economy — you're paying much more to get the right amount of light (hopefully) to your students.

Group Relamping

Consistently providing the right amount of light, eliminating electricity waste and reducing replacement product and labor costs is as easy as a lighting maintenance program. Lighting maintenance entails cleaning the fixtures and relamping them at scheduled periodic intervals.

Cleaning the fixture and lamps removes dirt and dust, allowing the most amount of light to reach those who need it. With certain surfaces, such as newly installed reflectors, sensitive wash techniques and solutions should be used to prevent scratching.

Group relamping — replacing all lamps in a system at regular intervals — is the backbone of any lighting management program. Most people look up and believe that since most of their lamps are lit, they don't have to replace the lamps. But remember that these same lamps, after they have operated for 70 percent of their expected life, begin producing up to one-fourth less light than they did when brand-new, all while you go on paying for 100 percent on your electric bill.

> *"The most important benefit of group relamping and fixture cleaning is that your teachers and students will enjoy maximum recommended illumination at the lowest operating cost.*

The replacement lamps you install can be energy-saving types with high color rendering — meaning they enhance fleshtones and make colors more vivid instead of offering the greenish color distortion commonly associated with fluorescent lighting. In addition, group lighting can be done in an assembly-line style, saving you up to 90 percent on your replacement labor costs.

Remember that most older lighting systems were designed to account for depreciation. That means that if you group relamp and clean the fixtures, you'll get too much light. This presents the opportunity to redesign the system or remove fixtures, saving even more energy, and money spent on replacement lamps.

Of course, the final and most important benefit of group relamping and fixture cleaning is that your faculty and teachers will enjoy maximum recommended illumination at the lowest operating cost. Through lighting maintenance, you'll spend less money than you do now on your lighting system, while consistently getting the most out of the light you pay for. This concept is logical, simple and it works.

Environmental Benefits

Most electric utilities burn fossil fuels to generate electricity. Despite advances in scrubbers, the use of low-sulphur fuels, and other pollution control technologies, by-product gases are released into the environment during the fuels' combustion: carbon dioxide, which is believed responsible for global warming; sulphur dioxide, a primary contributor to the phenomenon known as acid rain; and nitrogen oxides, which through photochemical reactions contribute to ozone pollution, or what we call smog. All are believed harmful to human health, our economy and our environment.

As you save energy through new products and eliminate energy waste through maintenance, you'll prevent the emission of these gases. The U.S. Environmental Protection Agency recently initiated Green Lights, a voluntary, non-regulatory program which encourages American corporations to upgrade their lighting systems to reduce air pollution, but only where profitable and where lighting quality is maintained or improved. Hundreds of America's top corporations, including Boeing, Xerox and American Express, have agreed to Green Lights' ambitious pollution prevention goals through quality lighting products and practices. The lighting management industry participates in the program as Lighting Management Company Allies.

Help That Pays For Itself

Choosing the right products. Insurance. Technology. Financing. Application. Installation. Maintenance. Your lighting system is an integral part of your efforts to educate students. Making the right choices so that you gain the most economy and most effective lighting requires a professional who knows how to upgrade a lighting system from start to finish — at a single fixed monthly cost.

No single product is a cure-all for inefficient and ineffective lighting — different spaces such as offices, classrooms, computer rooms, gymnasiums, science labs, storage rooms, stairwells and the teacher's lounge all present challenges and opportunities. Choosing a lighting management company to perform the work is not only economical in that the

company's services pay for themselves (while you make money), but it is the best way to ensure that the right products are chosen, correctly applied, correctly installed, and effectively maintained.

The lighting management company's first concern is effectively and economically lighting the space according to your needs, not simply selling you products based on energy savings. Lighting management services, which come with insurance for the workers and warranties for the products, are often available at a fixed monthly cost — making budgeting easier. And because the lighting management company works with you in a long-term partnership, its commitment to professionalism and accountability to you is paramount.

Lighting management companies gain their knowledge from experience in the field and from their involvement in the International Association of Lighting Management Company (NALMCO) of Princeton Junction, New Jersey, which represents the industry. Many members carry the Certified Lighting Management Consultant (CLMC) designation — which is your guarantee that you're getting the best expertise the industry has to offer.□

Norma Frank is past president of the International Association of Lighting Management Companies (NALMCO), based in Princeton Junction, NJ. She is also president of Colorado Lighting of Denver, CO. Frank is a Certified Lighting Management Consultant. For more information about lighting management and to find the NALMCO professional nearest to you, contact NALMCO, 14 Washington Road, Bldg. 5, Princeton Junction, NJ 08550; 609/799-5501.

Security and Safety

The Key to School Security

By Dan Hotle

Security systems were invented to provide privacy, protect property, and keep peoplesafe. While these remain their principal objectives today, the specific requirements for security products and systems continue to change from generation to generation. Seventy-five years ago, school administrators' major security challenges were not handicap access and tamper resistance. They did not have to worry about access control to the school cafeteria freezers and vending machines or theft at the school library. They did not have to be concerned about theft and vandalism in computer labs or safety in school parking lots.

School administrators' biggest security concerns centered around quality, durability, dependability and convenience of security products used in the school buildings, because there was neither the need nor the technology to produce the diverse array of security products we have today. A major challenge centered around the clumsiness and bulkiness of carrying around dozens of keys that were not interchangeable and that weighed more than 5 pounds. The introduction of the interchangeable core and masterkey system eliminated the need to carry numerous keys around for various school buildings.

Historically, changes in security systems have been slow. It took 4,000 years to integrate the pin tumbler lock concept developed by the Egyptians into the versatile and flexible pin tumbler cylinder that lock manufacturers produce today. It took another 100 years to modify that concept and develop the high security systems used in schools, homes, office buildings, and retail outlets today.

Historical Review of School Business Security

School security systems have graduated since they were first introduced in the United States in the late 1800s. The major evolution in locks and locking mechanisms has not been what materials locks are made of or even their design, but society's changing expectations of what the lock is expected to do and what has occurred to achieve those goals.

In the early 1900s, there was one basic locking mechanism, the mortise lock, that was operated by a bit key inserted directly through the door and into the lock case. There was no uniformity to these locks; they came in all shapes and sizes, varying in functions, shape and size based on where and how they were used.

Security features of the school mortise locks of yesteryear also varied greatly from today's school security systems. Latchbolts and deadbolts operated independently of each other and had a much shorter projection than modern locks. There were no UL requirements or standards governing their manufacture. The overall concern for security was not as great as it is today.

Along with the evolution of the mortise lock has come a complement of bored locks, deadbolt locks and miscellaneous locks that have been developed due to changes in installation requirements, security needs, economical concerns, and code changes. In the 1960s, cylindrical locks provided a new dimension in quality and durability. Accommodating handicap accessibility has led to development of lever-handled, bored and cylindrical locks.

Current Building Security

Today, while most secondary and primary schools use mostly mechanical hardware, there has been a shift to the use of a myriad of other systems to ensure the safety of students and employees.

These systems include alarms, intercoms and guard services. Innovations in technology in the access control industry have led to such items as closed-circuit television surveillance equipment, electronic access control systems, automated building security/fire systems, ID systems, and other security measures.

In addition to safety, school officials today are particularly concerned with theft and vandalism in libraries, parking areas,

computer labs, and food service areas.

Slow Shift to Electronics

Since the late 1980s, rapid changes in the electronics industry, the forces of change brought about by legislation, and an increasingly mobile and violent society are bringing forth a significant change in security systems for institutional, commercial and residential use.

The shift to electronic control systems has come about in the security industry to offer more security and greater flexibility. While most schools will be slow to adopt electronic security devices, there will be a gradual shift in this direction.

Switching to electronic systems in schools is accomplished by replacing the conventional lock cylinder with an electronic mechanism that accomplishes the functions of the pin tumbler system, with a host of other features. The conventional key is replaced with a plastic card, an electronic key or a push button key card.

Electronic locking offers many features that were not available before. Automatic locking and unlocking by time of day, a record of approved and denied access to an opening, instant rekeying and/or voiding of a keycard, use of the keycard as a student or employee ID, storage of student and employee information within the keycard, and added security because of non-duplication of keycards, are among the many benefits of the new electronic locking systems.

Legislative Mandates

As school administrators undoubtedly know, the Americans with Disabilities Act (ADA) went into effect in January 1992. The ADA is a civil rights law, not a building code. It is enforced not by building inspectors, but by individuals who claim discrimination. Normally a grievance will result in the correction of the accessibility problem. Additional violations could result in monetary penalties.

Perhaps the most far-reaching section of the ADA is Title III which deals with privately owned buildings and facilities which fall into two categories—public accommodations and commercial facilities. School buildings fall in the first category.

The ADA requires the removal of architectural and communications barriers in existing facilities (retrofit) where such removal is "readily achievable." Readily achievable is further defined as easily accomplishable and able to be carried out without much difficulty or expense.

Although the Justice Department has not established a numerical formula or threshold for determining "readily achievable," the following examples are measures that could be classified as such:

- Installing accessible door hardware;
- Widening doors to allow wheelchair access;
- Installing ramps;
- Making curb cuts in sidewalks and entrances; and
- Repositioning telephones and water fountains.

The ADA also addresses new construction and alterations affecting the use of a facility. After January 26, 1992, new construction and alterations have come under technical requirements as defined by the Architectural and Transportation Barrier Compliance Board.

To ensure that school facilities meet ADA requirements, school administrators should consult with the school architect and a security consultant and actually take a field survey of all school facilities to determine areas which need change.

Security Issues

In addition to legislative requirements, there are other security issues facing school administrators:

- Access control — the ability to secure facilities, monitor and track individuals and groups entering and leaving school buildings and facilities;
- Cost — not just the initial purchase price of the security system, but the cost for updating, retrofitting and maintenance;
- User friendliness of the security system;
- Durability and serviceability of the security system;
- Life safety precautions;
- Vandalism, theft and tampering of school security systems, facilities and equipment;
- Key control—who has keys and what measures are in effect to control who has keys and how quickly locks can be changed when security is breached or threatened.

Security Considerations

Here are some of the steps school business officials can take in considering security options, and some of the pros and cons attached to each:

Access control

When weighing the level of access control you think you require, it is important to first analyze your school's security, and access and handicap requirements, and weigh the economical feasibility of the options against the access control each provides. A simple approach to more effective access control that is often overlooked is to change from a pin and tumbler locking system to an interchangeable core locking system.

Cost

Often, schools purchase a system only to find they cannot maintain it, and then are forced to change to a different lock system and purchase all new locks. School administrators and maintenance personnel should consider the following when making a determination about a security system, whether for new construction or retrofit.

- How will the system be used?
- How long before the system is updated or replaced?
- What is it's initial cost?
- What are the hidden costs?
- How economical is it going to be operate and maintain?
- How easy is it to use and install?
- How easy will it be to get replacement costs?
- How quickly can I get technical and service help in case of a problem?

User Friendliness

When considering user friendliness, school administrators and maintenance personnel should carefully review the differences between interchangeable core and standard cylindrical locks. With the right combination of manufacturer support, service manuals, parts availability, and technical support and documentation, your maintenance personnel may find an interchangeable core system more efficient, expedient, and easier to use and maintain.

Durability and Serviceability

Here, the first step is to actually compare competitive locks — are they solid cast, or are they stamped and hollow? Their construction will shed light on their quality and durability. Also, reviewing the product's track record by talking with other school administrators about their experiences can often help you uncover any durability and service problems with a security product.

Life Safety Precautions

Every security manufacturer today offers lever-handled locks. A good precautionary step in taking a life safety inventory related to your school's security products is to confer with your architect to ensure that your systems meet all applicable local, state, federal life safety codes as they apply to your facilities and applications.

Vandalism, Theft and Tampering

The first step towards safeguarding against vandalism, theft and tampering is to install a higher grade security system versus a grade 2 system. In high-risk areas, there are mechanical lock products which deny and control access to provide additional security. Electronic products provide the same functions with the added benefits of managing and tracking access.

Key control

Many security system manufacturers offer computerized key control programs to ensure better key control. Several precautions are worth noting regarding these programs. First, that school administrators look into a security keying system which prohibits unauthorized duplication of keys in the marketplace as a routine precaution. Second, that you initiate a security and handicap access key control audit. Third, rather than official "housekeeping" during the summer when key control is normally addressed, we urge you to conduct a formal annual audit to review how effective your key control system is.

"A good precautionary step in taking a life safety inventory related to your school's security products is to confer with your architect to ensure that your systems meet all applicable local, state, federal life safety codes as they apply to your facilities and applications.

Security Systems at New Schools

In 1992, Dodge Construction Index forecast a 3 percent decrease in educational construction, and a similar decrease is projected in 1993.

School building construction cycles have historically related to generational cycles and population increases, decreases and stagnation. Since 1981-82, square footage of educational building construction has increased every year. By 1990, primary school construction had tripled and high school building had doubled, according to the Dodge Construction Index.

For new school construction, electronic products will be used primarily for perimeter access control and for areas such as administration offices, computer labs, vocational workshop areas, athletic facilities, bookstores, libraries and cafeterias. Mechanical hardware, primarily with interchangeable core systems, will continue to be specified for other areas at new secondary and primary schools due to the lower cost in comparison to electronic systems.

Resources

Participating in a local security association is the best way to stay ahead of new product trends and regulations that are pertinent to the school market. Among other organizations and resources that are helpful in this area are the American Society of Industry Safety, the Door & Hardware Institute, and the Construction Specifications Institute. Through the above organizations, and such groups as the Building Owners and Managers Association and the American Institute of Architects, you can receive information by mail about new security products and regulations such as the ADA which affect institutional buildings.❑

Dan Hotle is sales manager at Best Lock Corp. which serves the access control and security needs of schools, colleges and universities throughout the world.

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There *is* a Need for Alarm

How to Select a School Alarm System

By Steve Kaufer, CPP

As electronic wizardry continues to advance, improved technology and added features in alarm systems add up to enhanced protection. That's good news for school districts increasingly besieged with safety and security concerns.

New ways to use alarms are increasingly in the forefront as part of the solution. Yet alarm technology is only half of the equation for district administrators. The other half is finding the funds to purchase and maintain these systems. Schools faced with today's budget crises must cut costs everywhere, including security.

The answer for both problems lies in innovative, creative approaches to security that deliver a high level of protection at reduced cost. These alarm systems are designed to keep costs down, while remaining viable and saleable to both the district administration and the community. These advanced approaches not only result in an effective, cost-efficient system, but one that could well be self-funded.

This article will introduce you to the alarm system planning process and provide examples of approaches that have worked for other districts.

Initial Steps

From the time you realize you need a more effective alarm system, to when it is installed, you must complete several steps beginning with assessing the needs of the school district. Ask yourself: what needs to be protected? Start by looking at local crime trends and the experience of other school districts. Compare that with your district.

Determine if you are trying to protect each school 100 percent or if you just need to protect high risk areas, such as computer labs, science labs, music rooms and the administrative areas. Because most schools today have computers and audio visual equipment located throughout the campus, selective protection such as this becomes more difficult.

Some schools with limited budgets start out protecting basic facilities, then expand as more funding becomes available. While this usually costs more in the long run, it allows critical areas in each school to have protection and avoids the political problems that sometimes arise in protecting one school over another.

Designing an effective security system requires the input and involvement of all staff levels including district security officials, facilities personnel, financial and fiscal managers, maintenance and operations officials, school administrators, teachers and ranking district officials.

Designate a person to meet with each principal in the district as you compile information for a needs assessment. Also talk with teachers, other personnel, students, parents and site committees. Gathering this information provides a perspective of needs and helps pinpoint specific problems at each school. Knowing where past occurrences took place and which areas are most vulnerable at each site is especially important when designing a partial protection plan.

Sometime during the planning process you should call in an alarm systems expert to lend technical expertise. With today's complex technology, alarm systems are constantly changing. This makes it difficult for district operations or maintenance people to maintain a high level of expertise. Because they have so many tasks to oversee, no one expects them to be current in all areas, especially one as complex as electronic security.

This expert could either represent an equipment manufacturer or an alarm system installer, or the expert could be an independent security consultant. Each has advantages and disadvantages which you should examine carefully before making a choice. Base your decision on what you ultimately want in an alarm system.

Integration

When you begin looking at alarm systems, also consider how they might tie into other site needs. "Integration" has become the buzz word and a hot topic in the security industry today. It has to do with combining your alarm system with other systems and functions.

Other systems that combine well with security systems include:

■ *Energy management systems (EMS)*—In one Northern California district, energy management started off as a small part of the security system. Eventually, costs for the combined system reached $5.5 million, but energy savings in seven years will pay for both systems. Meanwhile, the district receives the benefits of 100 percent energy management and security.

■ *Access control*—Some school districts use photo identification cards for secondary school students, but use of access control systems in schools has been limited. Some systems control staff access to administrative facilities after school hours, including controlling alarm systems with access control cards.

■ *Closed-circuit television (CCTV)*—These systems, like access control, do not enjoy widespread use in schools, but present some interesting possibilities in monitoring school facilities.

System Elements

Typical elements of a security system include only two major groups of equipment for an effective alarm—the monitoring system and the control panel.

The monitoring system is housed at a central, 24-hour-manned facility that receives and interprets alarm signals from each school. An alarm company can operate the central station by including the district in its umbrella of clients, or the district can own and operate its own central station.

The other major component that makes up your protection system is the control panel. Most control panels use microprocessor-based electronics, which allow a variety of programming changes, including configurations, added features and user access codes, without replacement or modification of the hardware.

Many control panels may be reprogrammed remotely, allowing reconfiguration of the software from the district maintenance office, alarm company or other distant site. This feature dramatically reduces system down time for servicing.

Typically, the control panel includes an emergency power supply to ensure continuous operation. The panel supervises this power supply and signals the central station if it becomes low.

Before choosing a control panel, the rest of the system should be designed based on the needs of the district sites. Growth is a fact of life that must not be overlooked when selecting the control equipment. If you forecast future security needs in the initial planning, costly equipment upgrades can be avoided.

Installing an alarm system in a school that previously had unrestricted access after hours can cause concern and frustration among teachers and other personnel. Most districts want alarm systems to preserve and enhance the learning environment, not to restrict teachers who often work long hours on their own time. So careful planning must take place to ensure that the system meets the needs of both the district and its personnel.

System Control

While an alarm system is comprised of many elements, the system user's satisfaction depends on how it turns on and off. Choosing the correct device or method will either create or relieve anxiety over the use of the alarm. Here are some options:

■ *Key controlled*—out-dated and rarely used.

■ *Digital keypad*—uses a numerical code to arm and disarm the alarm system. Some panels have the capability of multiple user codes, which allow a record of who armed or disarmed the system at what time. That information is logged into the memory of the control panel for later retrieval, or is transmitted to the central station. Transmitting information to the central station allows a number of different management reports to be available. Some sophisticated control panels coupled with digital keypads can restrict the day and time that access codes are valid, giving the district greater control over after-hours access.

■ *Access control card*—controls the alarm as well as allowing access through controlled entrances. Like the keypad, this method can be capable of leaving a trail of information for later retrieval.

■ *Remote communication*—allows the alarm to be armed or disarmed from a remote site, such as the central station. This system helps personnel who are unfamiliar with the system, or who use it infrequently. All they need to do is call the central station and the alarms will be armed or disarmed remotely. Usually the caller must use a prearranged code for identification to have the system disarmed. The alarm can be programmed to automatically rearm itself after a specified amount of time.

This method is also useful for recurring events, such as community use of a multipurpose room. For example, you could program the alarm system to automatically disarm a selected area every Tuesday evening for a 7 p.m. event.

"While an alarm system is comprised of many elements, the system user's satisfaction depends on how it turns on and off."

Sensors

The first line of defense against intruders is usually sensors on perimeter doors. These magnetic

sensors are available in a variety of configurations, including surface and recess mounting. Care should be given to the type you select, because sensors are exposed to the most use and abuse.

Motion detectors are popular for protecting the interior of school buildings. While a wide variety are available, the two most commonly used are passive infrared and dual technology detectors.

Passive infrared (PIR) senses body heat to detect intruders. PIRs are designed to reduce false alarms from a variety of sources. One caution, however, is that in warmer climates you must use a high quality sensor that contains temperature compensation circuits to avoid the unit from becoming less effective as the ambient temperature in a room increases. For example, in the summer when an unoccupied classroom reaches 100 degrees or better, the range of detection may be diminished without a properly designed sensor.

Dual technology detectors, which are becoming increasingly popular in school settings, combine two forms of detection, usually passive infrared and microwave. Both sensors must trip to sound an alarm. This eliminates the potential for many false alarms. These sensors are more expensive than single technology sensors but are a good investment in reducing the potential for false alarms.

Both types of sensors are available in a variety of detection patterns to provide protection in classrooms, long corridors and other areas in education facilities.

A third class of sensor used commonly in schools is the audio detector. There are two primary types: one detects glass breakage, while the other uses a microphone linked to the central control panel. The first, typically mounted on the ceiling, is electronically tuned to sound an alarm if it hears various types of glass breaking.

The second audio detector is a microphone connected to the control panel. It contains circuitry that generates an alarm when a pre-set threshold of sound is reached. These sounds are not limited to breaking glass, but include other sounds that may occur during a burglary. Not only does this system generate an alarm signal to the central station, it also allows the operator to listen through microphones to sounds coming from the site.

Transmitting Alarm Signals

While monitoring alarm signals is a chief role of the central station, determining how the signals will be transmitted is a function of system design. The options are the same, no matter if the service is contracted to a vendor or in a district-operated central station.

The most common method of transmitting alarm signals is with a digital communicator. Typically built into the control panel, digital communicators use an existing telephone line. When an alarm is sensed, it electronically transmits the alarm to the computer at the central control station. Once the connection is made, the two devices interrogate each other and the digital communicator reports the site location, type and location of the alarm within the facility.

The central station computer interprets this information and displays it to the central station operator.

Digital communicators have several advantages. Because they use standard, existing telephone lines, you needn't pay an on-going fee for a communications link. The dial-up network is extremely reliable, with automatic routing around circuit problems should they occur. Additionally, if you want to change central stations it is a simple matter to reprogram the digital communications to the new station.

Disadvantages revolve around one of its advantages—the use of standard phone lines. If the lines are cut, or fail, the alarm cannot transmit to the central station. While that may appear as a weakness, telephone lines are rarely cut in low- to medium-exposure premises such as schools.

If your district needs a more secure signalling path, use a dedicated, or multiplex telephone circuit. This system connects a hard wire link to the central station. If the line is cut or experiences a technical failure it signals the central station. However, the cost to maintain a direct line could run into several hundred dollars per month. Moreover, since telephone companies are eliminating their hard copper circuits in favor of fiber optics and other technologies, it may be impossible to get a dedicated line.

A multiplex line, on the other hand, provides a high level of security, and is more affordable. The multiplex is a high security party line with a number of alarm systems using the same circuit to transmit to the central station.

Circuitry built into a transmitter at each site and receiving equipment at the central station polls each site every few seconds to ensure that the telephone link is secure and that no alarms have occurred since the last poll. Because this is a separate communications link, the telephone company charges an additional fee. Moreover, the equipment at each site is more expensive because of the addition of a multiplex transmitter. Unlike the digital communicator, a multiplex transmitter is not included in most alarm control panels today.

Radio signals present still another possibility for transmitting alarms to the central station. Compared to other technologies, radio is relatively new to the alarm industry. In most instances radio backs up the digital communicator if the line is cut.

Radio transmitters range from a simple slave unit that transmits to the central station, to more sophisticated, two-way systems that can arm or disarm the system or perform other remote controlled functions by relay. Some school districts, such as West Palm Beach, make extensive use of radios in their security programs. It takes a close examination from both a fiscal and operational standpoint to determine if this technology is right for your district.

"Silent alarms give responding police or security forces a better opportunity to apprehend the criminal, but also contribute more to false alarms."

Alarm Location

Another design decision that will affect the kind of equipment you choose is whether the alarm will sound at the school or just silently alert the central station.

Silent alarms give responding police or security forces a better opportunity to apprehend the criminal, but also contribute more to false alarms. Someone who has authority to enter a building or classroom may unknowingly trip the alarm, and thus cannot take steps to abort a police response.

Conversely, audible alarms minimize theft and vandalism. An audible alarm dramatically reduces short the amount of time a burglar or vandal spends inside a school facility. To maintain good community relations, however, the alarm should sound for a brief period and then rest. Most control panels have this capability built-in.

Safety Measures

As the possibility for violence in schools increases, district officials are looking more toward electronic devices to ensure the safety of students and teachers. Some schools are upgrading to voice communications systems, while others are installing personal protection alarms.

Teachers can wear miniature radio transmitters that summon help discreetly by simply pressing a button. It sends a signal to the school's administrative office that pinpoints who needs help and where they are. Another approach is to mount panic buttons in each classroom. Though less expensive than radio transmitters, the false alarm rate is significantly higher because these buttons are accessible to students.

Contracting Out Services

As you continue to analyze your security needs, you should determine which support services will be contracted out and which will be performed in-house. Your first consideration is installation.

Installation

Some districts contract for installation services because they lack the maintenance personnel to install a district-wide system in a reasonable amount of time. On the other hand, districts can become proficient in security systems by doing it themselves.

A Southern California school district contracted for a new system, then wound up completing the project after the installer went out of business. Today this district installs, maintains and monitors all of its systems. Installing new systems creates an in-house staff that is capable of maintaining, expanding and reconfiguring the system when changes are required.

Maintenance

Typically, the district staff maintains security systems once they are installed. If an outside contrac-

tor installs the system, be sure the bid includes training sessions to show staff how to trouble-shoot and repair components. A well-trained, in-house staff can save the district money. For example, they will learn that control panels contain sophisticated zoning capability which makes it easy to locate and replace a defective sensor. The staff will also learn to stock spare parts so that repairs can be made quickly and efficiently without interrupting alarm protection.

Monitoring

Monitoring the alarms is an area that requires the most thought and usually results in the most debate. Most districts contract these duties to an alarm company, but a growing number are establishing in-house central stations. Monitoring district alarms is a growing and on-going expense.

The cost of staffing a 24-hour, seven-day-a-week central station is substantial, in addition to the initial cost of acquiring the monitoring equipment. The cost issues can be examined in an unemotional, analytical manner, but other issues are a bit more thorny.

For example, alarm companies monitor a variety of customer alarms, often numbering in the thousands, making it difficult to give the same level of service that an in-house district central station provides. Because the district station deals only with school sites, staff becomes familiar with personnel, operating schedules, special events and other activities that affect alarm system operation. Familiarity helps to substantially reduce false alarms because district personnel in the central station have the discretion in dispatching that an an alarm company lacks, primarily for liability reasons.

You may consider a number of approaches to monitoring alarms. For example, hybrid programs have been developed for districts that combine in-house and contract services. This gives the district flexibility and saves the school money.

Another approach is to pool the resources of several districts. One district operates the central station and monitors the other districts' alarms under a cost-sharing agreement. Several districts actually turn a profit monitoring other district's alarms.

Respondents

Once you have decided the type of alarm system you need and who will monitor it, you must next decide who will respond when the alarm sounds. The ideal situation is to have district police or a properly equipped security department respond. No one knows your district or its schools better.

On the other hand, districts without police or a security department simply call police. But unless the responding officers are familiar with the school they may find it difficult to locate the source of the alarm, even with accurate zoning information. Often, police response to an alarm lacks high priority in many communities, leading to delays. Moreover, false alarm fines become a concern when local police respond.

One approach is to hire a contract security company to investigate alarms. Some districts have found this an effective way to virtually eliminate false alarm fines; guards responding are more familiar with the campus than local police. Fees vary for this service, and be either a monthly service fee or by the response.

Many districts use a call-out system to dispatch a custodian to the school to meet police, direct them to the alarm site and provide police with access. But this method could be expensive, since bargaining unit agreements may dictate minimum pay or other terms that may exceed the cost of a false alarm or private guard response.

False Alarms

False alarms are a source of aggravation and friction between alarm companies, police and you as the representative of the school district. They are the embodiment of the little boy who cried wolf too often. If you like lively discussions, try talking about false alarms with an alarm company representative or local police.

Police and alarm companies square off over the definition of a false alarm. Unless forced entry is apparent, police usually label it a false alarm. Alarm companies, on the other hand, say that the alarm was only doing what it was meant to do—scare off the burglar.

The same budgetary crisis that has befallen school districts is also affecting municipalities. False alarm fines are a new way of generating municipal income. Cities that have not had false alarm fines in the past are now aggressively implementing them.

A California school district was upgrading its alarm system from 14 percent protection to 100 percent. Based on past fines, that upgrade would likely have resulted in increased false alarms with penalties exceeding $30,000 a year. This illustrates that fines should be considered in the overall program cost.

However, the credibility loss in an alarm system is more serious than monetary losses. Too many false alarms can strain your relationship with the police, who should be your ally in combating crime. So consider the impact false alarms have on your budget and your credibility as part of your preliminary school investigations.

"Consider the impact false alarms have on your budget and your credibility as part of your preliminary school investigations."

Bidding Process

Once you've completed your research and analysis, you must then reduce those needs into specifications for the bidding process.

Typically, four types of specifications are used. They are called descriptive, performance, reference standard or proprietary. Se-

curity consultants prefer the latter. Proprietary spec's call out a specific device by the manufacturer's name and model number, along with substitution of approved equals. This gives consultants the greatest opportunity to ensure the quality and functionality of the system.

District bidding documents provide a guide for the new system, but alarm systems and monitoring specs have a few unique points of their own. For example, the installation techniques, such as concealed wiring and the use of conduit for exposed wiring, prevents vandalism and tampering.

Moreover, because security equipment is a favored target of mischievous students and vandals, other precautions in the specifications are also necessary, such as requiring concealed sensors, recessed mounted motion detectors, mesh ball guards, and tamper resistant screws.

Furthermore, most alarm companies won't sign a standard district contract or be governed by the typical language of a purchase order. The contractual requirements of the alarm company's insurance carrier usually precludes the company from executing contracts without specific exculpatory language that limits the alarm company's exposure to liability. This factor requires consideration and negotiation with your vendor.

A final consideration of your new alarm system is the quality of its components. System hardware is almost universally Underwriters Laboratories (UL) approved. All devices, hardware and wire you have specified should be UL listed. Additionally, UL lists alarm installations and central stations.

High-risk sites, such as jewelry stores, are required to install UL certificated security systems. On the other hand, schools are not required to have security systems that meet those standards. But you may wish to specify that the central station that monitors your alarms be UL listed. That will ensure that the facility meets rigorous standards including construction, fire safety, back-up power and staffing.

Training

As mentioned earlier, training is a vital aspect of your new security system. Be sure that adequate training is specified in your bid documents.

All personnel authorized to have after-hour access should receive initial training. Without that training, false alarms will undermine the credibility of your new system. Either thoroughly trained district personnel or an alarm company representative should provide training at individual sites.

Authorized staff should also receive written instruction, preferably wallet-size, because it could be months between learning about the system and finding the need to operate it. The caveat to providing written instructions is that the person will likely write down the combination to the alarm system so as not to forget it. Therefore, be sure and leave all logos and other identifying marks off the instruction card. You must also establish a program of follow-up training which may be either periodic or in response to a rash of false alarms.

Maintenance and installation provides another aspect of training. If you are buying equipment to establish your own central station, it will likely include monitoring software. Here, too, you should receive complete training in the initial setup and use of the system. Because most companies offering alarm monitoring software offer support and upgrades you should specify those items in your bid documents. The support agreement should be between you and the software supplier, without the alarm dealer in the middle.

Affordable Protection

Most school systems have some sort of alarm protection now. It may be a collection of alarms from local vendors protecting key areas on a variety of campuses. If you have decided to upgrade, it's best you take an overall look at your security system as though you were starting from scratch. This is an ideal time to evaluate your entire security program and the alarms that are part of that effort.

Electronic technology is more than sophisticated gadgetry. It is your key to improved safety throughout your school district, while potentially paying its own way.□

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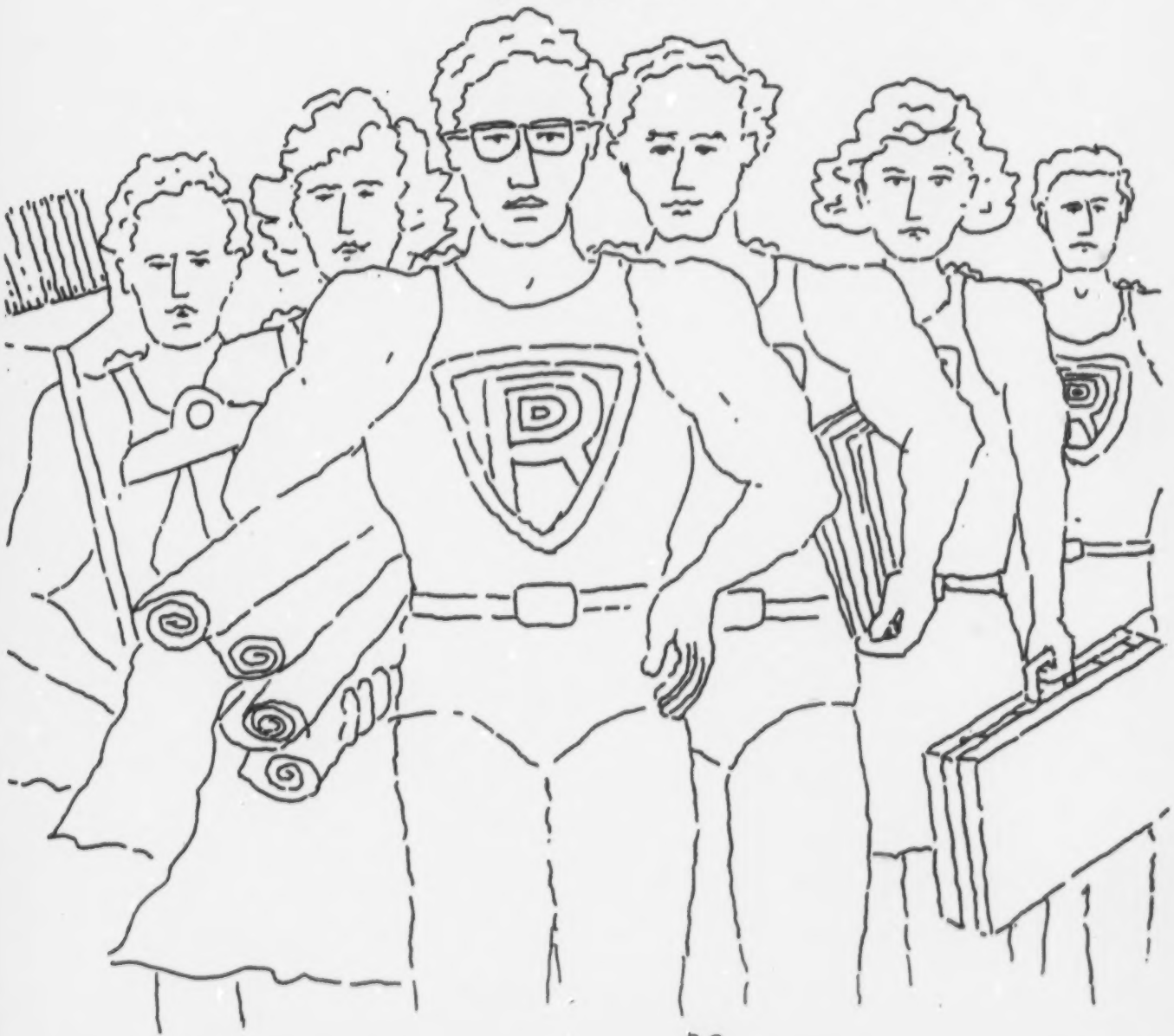
The School Disaster Recovery Team: A Concept Whose Time Has Come

By Dr. Lester Perry



(Editor's Note: This article was sent to our offices on October 15, 1989, just two days before the San Francisco Bay Area was devasted by an earthquake, and only a short time after Hurricane Hugo struck South Carolina, North Carolina, and the Virgin Islands. The timeliness of the information in this article needs no further mention — The Editors.)

In reviewing the literature on school disaster recovery, it quickly becomes apparent that this concept has been ignored by most professional educators. While the professional educational journals are laden with articles on curriculum, student discipline, effective teaching, evaluation, school facilities, accounting, and other educational topics that have or are currently riding a crest of popularity, not one single article could be found that covered the concept of school disaster recovery in a comprehensive fashion; in fact, only a handful of articles over the past 20 years have even addressed the issue at all.

In an environment where each year many schools around the country are being damaged or destroyed by disasters, it would appear that educational researchers and administrators are not preparing adequately for the possibility of a sudden catastrophe that would both cripple the educational progress and drain the financial resources of the district. For those who have directly experienced a school disaster, too often they realized that a lack of anticipatory planning added to the confusion, frustration, and expense of the disaster. The real disaster is the school district's not being able to manage the immediate crisis in an organized, preplanned professional manner.

The literature also indicates that the potential for disaster in public school systems is perhaps greater today than ever before. The sheer size and magnitude of school systems, the number of school buildings, and the variety and complexity of material and equipment within these buildings increases the risk of confronting a disastrous situation. This added risk places school administrators in a position where disaster can strike at any moment.

Each year hundreds of school systems across the United States are victims of disasters. When a disaster occurs, school administrators and school boards are shocked to realize the enormous task facing them. Too often they are quick to realize that many things they planned to do should have already been done.

Disasters which may affect schools arise most frequently from fire, water, smoke, and structural failure. "Examples of events or situations from which emergencies may follow are:

- Fire – immediate sources of fire may include accidents, defective equipment and wiring, arson, vandalism, and smoker's carelessness.
- Water – flooding may follow from fire fighting, leakage from burst pipes, and exposure to weather as a result of structural damage attendant to earthquakes and storms.
- Smoke – soot and other pollutants may be generated by the burning of electrical cables, machinery, and transmission equipment, and the ignition of furnishings, draperies, wastepaper, and packing material.
- Structural failure – earthquakes, explosions, fires, and storms are the most frequent source of building damage."[1]

A major component in any type of Disaster Recovery Plan (DRP) should be a Disaster Recovery Team (DRT) comprised of both educators and noneducational personnel. A coordinator should be appointed by the superintendent to direct the design and implementation of a school recovery plan as well as to supervise all components of the plan. This coordinator should be someone already employed by the district, but not an administrator. It is felt that by having a teacher as coordinator, it will aid in getting other teachers involved in the project as well as adding more objectivity to the plan. This teacher could either be given some release time or an extra stipend for directing the project. This person should be well organized and possess good managerial skills.

The person selected to be coordinator should receive detailed training in disaster recovery planning. This could be achieved by traveling to school districts that do have such a plan and talking to personnel, by meeting with professionals who have expertise in the area of disaster preparedness, or by taking workshops to train for disaster recovery. If the coordinator is going to organize, promote, and help evaluate the overall plan, then it is vital that this person be knowledgeable and well trained in the concept of disaster recovery planning. The coordinator's delegated authority comes directly from the superintendent, and this person is responsible to the superintendent in all planning and implementing stages and in any recovery attempts following a disaster. In the event of an actual disaster, it is this person who will mobilize the Disaster Recovery Team (DRT) and direct the team in its evaluation and recovery efforts.

The role of school personnel in designing, implementing, evaluating, and actual involvement in recovery procedures after a disaster is vital.[2] Each individual is part of a team effort, yet has specific duties and responsibilities that are important to the success of the team and essential to any recovery plan. The team should undergo training in emergency recovery techniques, be familiar with different types of recovery plans, and have a thorough knowledge of the school's DRP. The major responsibility of the Disaster Recovery Team is to spearhead all recovery procedures in the event of a disaster. The team, under instruction from the superintendent, would issue immediate directives to secure the building, notify proper authorities, and evaluate the situation. The team, headed by the coordinator, would be involved in all phases of recovery.

In the event of a "major" disaster, the coordinator would call the Disaster Recovery Team into action. The team would make

an on-site inspection, evaluate its finding with regard to property and materials, and make a written report to the superintendent. This report would summarize property damage, any property and materials in danger of further damage, priorities for saving materials and equipment, the immediate procedures as well as long-range actions to ensure recovery, and warranted security measures. "Throughout the recovery process, the DRT will work to achieve the greatest continuity of service that the conditions will allow."[3]

Before beginning the actual cleanup process, the DRT, staff, administration, and any other people involved in the recovery effort would be briefed on the procedures to be utilized. Steps outlined in the Disaster Recovery Plan would be reviewed and specific responsibilities not already allocated in the plan would be assigned at this time. The recovery process should be a well-planned, structured, coordinated effort headed by the team coordinator and supervised by the Disaster Recovery Team.

One of the first priorities of the DRT is to determine if the building is structurally safe to enter. Once this information has been ascertained, and it is safe to enter the building, the team needs to determine if any safety hazards inside the building are present. "PCBs, asbestos, or other hazardous materials may be present in the air or on surfaces but may remain undetected unless experts in hazardous materials are brought in to examine the situation."[4] Corrosion and bacterial growth are also major concerns. They may be present but not visible until they have caused extensive damage. For this reason it is important to use consultants who are knowledgeable in problems associated with a disaster. "A full-service restoration company with experience in these areas can quickly and expertly identify problems and outline a program for dealing with them on an emergency and long term basis."[5]

It is important to stress that all school personnel should be involved in the designing of a DRP. This does not mean, however, that all staff should have intensive training in specific disaster recovery techniques. This would be far too expensive and impractical. While it is necessary for all staff members to receive training about the concept of disaster recovery in order to intelligently participate in the designing of the DRP, once the plan has been implemented, the participation by most staff members is concluded. The Disaster Recovery Team is an ongoing unit that receives far more training than most staff members because the team will actually by utilized in the event of a real disaster.

Team members should be selected on a volunteer basis and be compensated via either release time or a small stipend. The team's function is not to do the work of emergency agencies or private contractors in a situation where a disaster has occurred, but rather simply to conduct a needs assessment relating to educational concerns and to implement specific disaster recovery techniques involving educational supplies, materials, and equipment as outlined in the DRP. Only personnel with an educational background are in a position to evaluate the facility, materials, and equipment from the perspective of what is usable and what is needed to continue the educational process for the students. The team simply uses their educational training to make decisions that only practicing educators can make. This concept is taken one step further by training these same educators in rudimentary recovery techniques so that valuable educational materials and equipment may be salvaged and put back into use with the least amount of disruption. The single priority goal of the DRT is to get the school environment back to normal as quickly as possible. The quicker the school is normalized, the less educational time is lost for students.

The Disaster Recovery Team should be composed of a variety of personnel, both school personnel and noneducational community personnel. Each member should possess some special knowledge base that contributes to the goals of the DRP. As already stated, the coordinator will head the team and be responsible for all activities and training of team members. An architect, preferably the district's architect,

should be a team member. This person will possess an in-depth professional knowledge of structural design and design utilization, and will be a valuable resource for subcontractors in the community. If a disaster occurs, this person will be a primary source to determine the condition of the building and to secure and supervise professional assistance. Professional consultants within the community may also be utilized as team members.

The DRT is a district team and therefore should have members from each school represented on the team. It is difficult to determine how many members should be on the team because that directly depends on the size of the district and the number of schools involved. The team should only be as large as is necessary to carry out the objectives of the DRP in meeting the needs of the district and each individual school. Key school personnel on the team might include staff from the following areas: physical education, industrial and vocational education, computer science, business, special education, as well as representatives from the maintenance staff, cafeteria staff, library staff, central office/clerical staff, and audiovisual staff. These people represent areas of special concern in the event of a disaster, and each person has a base of knowledge pertaining to a specific area that would be vital in the decision-making process. Selection of these people from various school buildings would help determine the make-up of the team. Optimally, each school will have one representative on the DRT.

Since all money and expenses are filtered through the business office, the business manager is in an excellent poistion to screen and counterbalance the massive spending that takes place when a school has been destroyed or partially destroyed by a disaster.

In addition to the above mentioned professionals, the administration needs to have a representative on the DRT. It is recommended that the district business manager be a member of the DRT. In a time of crisis, many financial decisions have to be made and made as quickly and objectively as possible. While it is usually the superintendent who makes recommendations on these issues to the school board, it is the business manager's responsibility to keep track of all financial matters relating to the district's budget. It therefore makes sense to have this person directly involved in the recovery process. By being trained with the other team members, the business manager will have a comprehensive understanding of the DRP and will be actively involved from the start in all recovery activities and decisions.

A secondary reason for having the business manager actively involved as a team member is that usually this person works closely with the insurance agents/brokers that have written the insurance policies for the district. If the business manager is well trained in disaster recovery, he or she is in a better situation to evaluate, explain, and verify losses to the insurance agents. The business manager already has a relationship with the insurance agents, so this should serve to expedite all claims and paperwork associated with filing for insurance. The business manager functions as an intermediary between the insurance companies and the district, and this is especially important for the DRT when important decisions concerning finances have to be made.

Another important reason for having the business manager as part of the DRT is that this person tends to be a stabilizing influence in times of crisis. The role of the business manager tends to make an individual very objective in the decision-making practices within the district. In times of a disaster, many personnel forget about money constraints and try to restore normalcy to the school without regard to the cost factor. The business manager is very cognizant of the district's budget and should ensure the best value for each dollar spent. Since all money and expenses are filtered through the business office, the business manager is in an excellent position to screen and counterbalance the massive spending that takes place when a school has been destroyed or partially destroyed by a disaster. While this person can have a positive influence on controlling spending, the business manager can also stifle recovery attempts by being too frugal and not allowing the purchase of items that really need to be purchased. By being on the recovery team, there should be better communication and cooperation among personnel, and a check and balance of all expenditures. The role of the business manager as a team member will be pivotal in the decision-making process concerning all financial matters of the district. This person should not be the coordinator of the DRT, however, since objectivity to the goals of the team might be at risk.

Members of the DRT must know and understand the Disaster Recovery Plan. They must understand their roles within the plan and what is expected of each of them if a disaster occurs. Individual objectives must be defined, and personnel must be trained to accomplish the objectives. Each member of the team is responsible for specific tasks, yet the collection of individuals must function using a team approach. The role of each individual must be stated in the plan, along with specific objectives, procedures, and evaluation techniques.

Team members must be trained by professionals who have experience in disaster recovery techniques. Training can be conducted by consultants, community members with expertise, or school personnel who have already been trained in recovery techniques. Once the original team is trained,

they can then train replacement personnel as needed. It is important that team members receive detailed training in recovery techniques that will allow them to accurately evaluate, then salvage as much educational material and equipment as possible if a disaster should take place. The DRT is an extremely important component of the DRP as it is the team that conducts the needs-analysis directly following the disaster.

While many recovery procedures are self-explanatory, some are so important as to demand individual attention. While no single step or procedure is more important than any other, some steps are often overlooked and need to be emphasized.

Corrosion control must be performed on all electrical and mechanical equipment. This is accomplished by removing all corrosive residue on the housing and applying a corrosion inhibitor to displace moisture and stop the corrosion process.

Emergency procedures for water-damaged books, school records, and equipment need to be understood and planned for within the DRP. Many of the school records, books, and teaching materials cannot be easily and quickly replaced, so restoring the damaged property is the only reasonable option. There are many procedures to salvage these materials, but time and equipment are essential. Restoring documents must be done quickly if items are to be saved from further damage. Industrial freezers are used to dry out paper materials and prevent mold and mildew. One important consideration is to determine if items should be saved or if only the information should be salvaged. Often it is more cost-effective to microfilm records and files rather than clean them. Advanced planning and prompt attention after the disaster has occurred will ensure maximum recovery of important documents.

Another area of major concern in the event of a school disaster is salvaging information that has been computerized. Many school districts are now storing most of their school information and student records on computer disks. In the event of a school disaster, it is imperative that this information be able to be retrieved. The best means of ensuring the safety of this information is to have back-up copies of the information, but this may not always be the case. There should be members of the DRT who are well-trained in computer information retrieval. This should not present a problem as usually there are staff members who are very knowledgeable concerning computers, and only minor training may be necessary to achieve the stated objective. These indi-viduals should know how to organize and store computer information, extract information from damaged disks, have knowledge of the different computer systems within the district, and have some training in techniques to salvage computer hardware once it has been exposed to large amounts of moisture, which then causes electrical and corrosion problems.

In summary, after designing and evaluating the Disaster Recovery Plan, appropriate school

personnel need to be informed and trained on their specific responsibilities within the plan. A major component in any school disaster plan should be the development of a Disaster Recovery Team. The goals and objectives of the team within the overall Disaster Recovery Plan need to be periodically reviewed and updated. In the event a disaster does occur, the DRT should be activated once evacuation and safety measures have taken place. It is important to remember that the first 24 hours after a disaster are critical because many important decisions must be made immediately following the crisis.

The first step in developing a DRT is to appoint a team coordinator. Once this is done, then other team members can be appointed based on the school they represent within the district and the technical contribution they can make to meet the goals of the recovery plan. All team members then need to be trained in specific disaster recovery procedures and techniques to reduce school damage in the event of a disaster. It is important that roles and duties are clearly defined for each team member, and training must take place to enable each member to complete the duties that are assigned.❑

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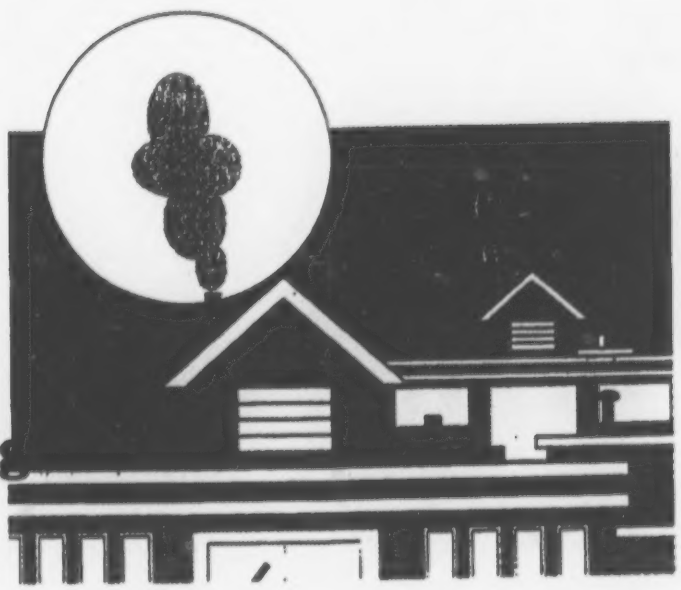
Short-Term Disaster Recovery Procedures

The following is a list of procedures that the Disaster Recovery Team would undertake immediately following a school disaster. This list is not meant to be comprehensive, but rather a sample of the type of activities that a DRT would be responsible for in the event of a school disaster.

1. Contact outside security service (DRT).
2. Contact public utilities and service companies (DRT).
3. Assess the damage to determine whether classes can continue in the building or whether temporary quarters will be required (DRT and Superintendent).
4. Authorize temporary construction to seal off damaged area (DRT).
5. Advise students, faculty, parents, and the community as information becomes available (DRT and Superintendent).
6. Execute disaster recovery techniques to reduce corrosion and bacteria damage (DRT).
7. Determine treatment needed to salvage all material/equipment, then execute disaster recovery techniques to reduce water-damage on all materials (DRT).
8. Assist in debris removal (DRT).
9. Supervise the removal and cleaning of all items from affected area (DRT).
10. Salvage office records, computer files, student records, and other private information (DRT and Superintendent).



Roofing

Buildings & Grounds

An Introduction to Roof Management

By Larry W. Waldron, R.C.I.

With annual school maintenance and construction budgets more and more frequently being subjected to the economic adjustment ax, buildings and grounds administrators must accurately identify and substantiate the myriad financial expenditure needs of their facilities.

To help with these predictions, many administrators have acquired physical plant maintenance software packages that, for example, identify frequency ratios for replacing light bulbs or cleaning air handling unit filters, as well as other such periodic maintenance/replacement functions. Many of these programs provide scheduling for various other maintenance functions and some will actually print out daily work orders for maintenance and custodial personal.

With such programs, routine maintenance can be planned allowing emergency or unexpected maintenance calls to be handled by a centralized response team from maintenance headquarters. In smaller school systems, emergency or unanticipated problems might be handled by on-site facility personal or local contractors.

No matter how maintenance is handled, however, one headache is mentioned most frequently. During my past 18 years in this field, whether the comments have come during conversations, after speaking engagements, or in other contacts with building owners, almost everyone puts roofing and roof-related problems at or near the top of their maintenance headache list. This level of concern is also true for the private sector, from property management companies to physical plant engineers in industry to developers of commercial and residential-use properties.

One of the common complaints is that a roof, which had been leaking periodically but was repaired, suddenly "went bad," requiring total replacement with no money budgeted for this "unforeseen" emergency.

Other comments include complaints that a new roof put on a building just a year ago is experiencing leak problems, but neither the manufacturer of the roofing materials nor the roofing contractor is willing to help rectify the problem.

These concerns are certainly justified. Yet, when asked about their roof management program or approach, most of the complainers responded the same way: "What is a roof management program?"

Roof management may best be described as the concept of establishing a systematic approach to the collection of an accurate database on the existing condition of one's roofs and the development of a budget-supported plan of action to address these discovered and then-prioritized problems.

In other words, roof management is a fiscally responsive method by which to prepare for roof-related expenditures on the basis of known parameters. Thus, roofing-related surprises are minimized, and accurate budgeting for both financial and human resources can be developed more readily.

In conceptual terms, roof management seems reasonably simple. As in most systematic programs, there are many facets of developing a well-designed program that will truly result in freedom from crisis management of roofing problems.

Aside from assisting the buildings and grounds administrator in escaping the nagging headaches of crisis management, a well-conceived and properly implemented roof management program will reduce the overall "in service" cost of roofing. This reduction in the "in service" cost is a function of many components of the program working in concert to exact a longer service life or life cycle from existing and future roof installations.

The generally accepted primary components of a well-conceived roof management program are:

- Accurate Roof Analysis;
- Proper Roof Design;
- Quality Workmanship;
- Roof Maintenance;
- Roof Condition Reporting and Record Keeping.

Each of these primary components also includes multiple subtask components that must be completed in order to properly implement the roof management program.

Over the next few months, this column will delve more deeply into these components and how each fits into the overall roof management program.

Then you'll be ready to implement an effective roof management program that will allow you, to be on *top* of your roofing expenditures as opposed to being *covered up* by them.□

Larry W. Waldron is the Senior Roof Consultant for the Springfield, Virginia, office of the Roof Consulting Division of Professional Service Industries, Inc. He wrote an article on planning for summer roofing projects for the December 1988 issue of School Business Affairs.

Buildings & Grounds

Testing the Cost Effectiveness of a Roof Management Program

By Larry W. Waldron, R.C.I.

Last month, the concept of a Roof Management Program as a financial planning and maintenance tool was introduced.

The true test of any program designed to enhance financial management is whether the program is cost effective from both an administrative and implementation perspective.

An additional test of a maintenance management program is whether the implementation of it will result in a net savings of both time and money with an improvement in efficiency over prior methods.

To answer these questions regarding a Roof Management Program the first step is to examine the prorated annual cost of a roof. The life cycle cost of a roof can best be expressed utilizing the following algebraic equation:

$$A = \frac{C + M + R + E - S}{L}$$

The relative values expressed by the variables in this equation are as follows:

A = Prorated Annual Roof Cost
C = Initial Cost of Construction
M = Cost of Maintenance
R = Repair or replacement costs of other building components as a result of roof leaks
E = Energy loss through wet insulation (cost)
S = Salvage cost for various components of the roof
L - Effective service life in years.

As previously stated, the objective of roof management is to effectively keep the Prorated Annual Roof Cost (A) as low as possible.

In the mathematical calculation above, to get a smaller quotient, (A), we have the option of either reducing the numerator (C + M + R + E - S) or increasing the denominator (L). Since the value of the initial cost of construction (C) is a constant, the only true variables that affect cost effective roof management are contained in the rest of the equation.

With the value for the cost of maintenance (M) being the primary controlling factor, the other four values are directly responsive to the rate of expenditure for cost of maintenance (M). The values for salvage cost (S) and effective service life (L) are directly proportional; thus, mathematically justifying the obvious, the better roofs are maintained the longer they will last.

The values for repair or replacement costs, because of roof leaks (R) and the energy loss through wet insulation (E), are considered inversely proportional; thereby proving that the better roofs are maintained, the less the costs associated with building component repairs or replacements and energy losses as a result of roof system leaks will be.

With the help of the mathematical equations above, it can be determined that, if what is spent in maintenance is increased as much as needed to reduce (R) and (E) and thereby proportionally increase (S) and (L), the costs associated with implementing an effective roof management program can be justified. In fact, such a program will, in effect, reach a point of beneficial return after a period of operation due to certain roof components (S) and (L) values exceeding projections.

The beneficial return of effective roof management will become immediately tangible with the first reroofing project that is accomplished without necessitating the removal of the existing roof due to salvageable roof insulation. This savings alone would represent a labor only cost reduction of $0.50 to $1.00 for each square foot of roof area salvageable. Additional savings may well be obtained by a reduction in the cost for additional insulation owing to the viable thermal resistance, "R", value of the salvageable existing roof insulation. Other tangible evidence of the beneficial return on the investment cost of implementing an effective roof management program will present itself almost immediately, not the least of which is the knowledge that you, the buildings and grounds administrator, are finally on top of your roofing expenditures as opposed to being covered up by them.

The next article will disclose some of the specifics associated with one of the five primary components of a viable, cost-effective roof management program.❑

Larry W. Waldron, R. C. I., is the Senior Roof Consultant for the Springfield, Virginia, office of the Roof Consulting Division of Professional Service Industries, Inc.

Buildings & Grounds

Getting Started in Roof Management

By Larry W. Waldron, R.C.I.

In the previous two articles on roof management we have attempted to both introduce the general parameters and establish the cost effectiveness of the concept of roof management.

This article is intended to provide a general guideline, or flow chart of events, to assist those interested in possibly setting up a comprehensive roof management program in their own school system.

The initial step in the process is to determine exactly what the needs are to set expectations. This first step is not as simple or obvious as it may appear for a variety of reasons. Principally, the initial step entails the establishment of a development team and determination of the various information needs that the database should be capable of satisfying. The best method of accomplishing this task involves obtaining input from the various personnel responsible for related functions regarding asset management and maintenance. The development team normally includes representatives from the following departments or responsibility areas:

- Financial planning and budgeting;
- Facility maintenance;
- Administration; and
- Data processing.

If an "in house" architectural/engineering department exists in the school system, representatives from this group should be included as development team members as well. In fact, in school systems that have this capacity, the manager for this department is often selected as the program director.

Given the need for effective, unbiased review of the current methods of handling roof maintenance and the related expenditure of funds, many school business administrators elect to obtain the services of an "outside" consultant to perform the initial needs survey and conduct the needs analysis. This approach most often results in less friction between the representatives of the various departments and provides an objective opinion regarding recommendations for any methodology changes, as well as additional components or parameters that should be included in the roof management program.

If an "outside" consultant is to be hired, the selection process should include provisions to ensure that the consultant will derive his or her income solely from the roof management program development effort. This provision will ensure that the consultant will not have a potential conflict of interest with regard to recommendations for methods, materials, or equipment to be utilized when the program progresses to the implementation stage.

Once the decision regarding the development team members and the program manager has been made, the program manager should seek to obtain input from the other members that will identify the information needs of the program database. In other words, what information does each related department need to assist them in making fiscally responsible decisions with regard to roof-related expenditures of time or money?

As presented in the May issue of this magazine, the primary components of the roof management program are:

- Accurate roof analysis;
- Proper roof design;
- Quality workmanship;
- Roof maintenance; and
- Roof condition reporting and recordkeeping.

Interestingly, it is the roof condition reporting and recordkeeping component that should be addressed first in the needs analysis phase of a roof management program development effort. In fact, it is quite often determined during the needs analysis activity that this aspect of the current roofing maintenance effort is the most neglected.

As is true of many commercial entities with multiple facilities, few school buildings and grounds administrators or financial administrators can readily determine the necessary budget amounts for roof maintenance, repair, or replacement, due to a void in their knowledge of the actual condition of their roofs. Thus the roof information database and the necessary records of activity and cost must be given a high degree of attention in the initial steps of roof management program development. The accuracy in properly evaluating the full scope of useful data to be recorded for use by the various departments or divisions within the school system's administration, and development of a logical, systematic approach to the information gathering and storage process will effectively determine the success and cost effectiveness of a roof management program. Failure to adequately identify information need parameters for the program database will result in an inefficient and incomplete program with limitations on its usefulness to the school system administration.

In recent years, various companies have created computer software packages to assist multi-facility owners in setting up a record storage and retrieval system for roof maintenance. Some of these software packages are extremely versatile, with budgeting and critical problem preordination or ranking capabilities while others are basic electronic filing system with limited category storage provisions.

If the decision is made to purchase a prepackaged data storage system for the recordkeeping component of the roof management program, considerable care should be exercised in evaluating the various data storage software packages available. The prudent administrator will select a software package that is user friendly, contains adequate categories for data storage, and can store sufficient data to be of value to all divisions or departments of the school system administration.

Regardless of which software is selected, the school system should elect to own the software and have complete access to the data stored within it, rather than be reliant upon a vendor who retains the software and provides selected data printouts. This vendor approach is often a cumbersome process due to time delays in accessing the information, as well as requiring a continual dependence on the vendor. In some instances, the printout vendor may have a vested interest in making additional sales of products or services to the school system with each printout request providing a signal for a salesperson to call.

In a future article on roof management, the author will present a listing of some of the roof management software packages and vendors available.□

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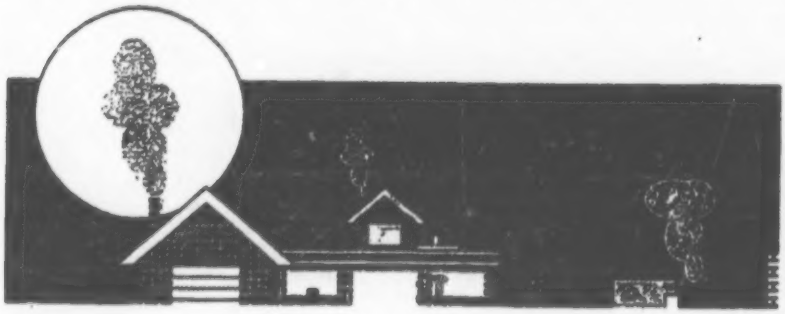


Preventive Maintenance The Key to Preserving Roofing

By Robert Jon Napier & Hazel Ephron

Because roofs are one of the most important and most vulnerable parts of a building, reroofing accounts for the major part of preservation activities in older school facilities. When school administrators talk about roofs, the topic is rarely about putting down a new one. It is about the repair and maintenance of a roof as part of an ongoing preservation program, involving windows, parapets and masonry repair in conjunction with reroofing and drainage replacement.

The most critical fact for any facilities manager or administrator to remember about a roof is that it doesn't exist independently from the rest of the building's elements. Reroofing or the correction of roof leaks very often also involves repair and reconstruction of other building elements.

To forestall deterioration, an evaluation at least twice a year is required to determine preservation actions. Roofs, after all, are subjected to more climatic stress than any other part of the building. The sun is one enemy; rain is another. Water collecting on the roof will find its way through open seams of flashings and membrane. Climatic changes themselves result in cracking and deterioration. In various parts of the country where there are extreme changes in weather, numerous freeze/thaw cycles occur during a year causing continual expansion and contraction of materials.

Inspection of Components

An inspection of components will determine if any or some of the following actions are required: maintenance, major repairs, reconstruction, replacement, or further analysis under the direction of a consultant. There are three basic components to all roofs, which can be visually evaluated. First, there are the roofing materials themselves – the parts that makes a roof waterproof. This includes membranes, shingles or metal sheets. Second, there are flashing – layers of metal set between roofing membranes and other construction material to shed water and direct its flow. Third, there is a drainage system to carry away water that collects on the roof.

Before the inspection begins, it is necessary to identify the kind of roof on the building. There may be more than one kind of roofing material and/or more than one roof (don't overlook those small roofs on top of stairway bulkheads). School building roofs run the gamut when it comes to roofing types. Schools that were built in the first 20 years of the century and in the 1930s and 1940s are mostly of the built-up variety. In the 1950s, a whole new wave of facilities were built with newer roofing types.

In addition to built-up roofing, some of these roofing types include metal sheet, asphalt shingle, clay tile/slate shingle and single-ply membrane. Most buildings that were constructed prior to World War II have built-up flat roofs that are composed of bituminous material and roofing felts.

Built-up roofing (BUR) is so called because it is "built-up" on site using several layers of sheet material ("felt") sealed together with bitumen (asphalt or coal-tar pitch) and covered with a material or gravel topping. This kind of roof is often found on gently sloping and almost flat roofs. It must slope to one or more low points where drains or gutters carry away stormwater. BUR acts as a continuous waterproof skin when in good condition. It should last 10-15 years from installation without needing complete resurfacing or replacement.

The second part of the roofing system that must be examined and evaluated are flashing — layers that seal and protect joints in a building to prevent the penetration of water. Flashing is commonly found wherever roof surfaces intersect with each other or meet vertical surfaces. There are two basic types of flashing on

flat or pitched roofs — cap flashing and base flashing. Steeply-pitched roofs have flashing in valleys and on hips and ridges. Other typical locations are at chimneys, expansion joints, vent pipes, skylights, and roof eaves.

Base flashing is the portion of roofing material that turns up against a wall or other vertical surface. Cap flashing is built into the vertical surface just above the base flashing and turns down to cover the top of the base flashing. Together, the flashings make a watertight assembly to prevent water from penetrating the edges of a roof. Newer roofing systems eliminate the need for cap flashing by use of a metal bar secured to the top of the base flashing and sealant.

Flashing may be either exposed or concealed within the structure of the building. Cap flashing is always exposed and usually made of sheet metal. Typical metals are aluminum, copper, painted galvanized steel, stainless steel, monel, terne, lead or zinc alloy. Base flashing is partially exposed and, unless metal, is usually made of a similar or compatible material to the roof surface. Felt, woven fiberglass mesh, rubber and plastic sheet materials are most commonly used.

The third basic roofing component that must be periodically checked and maintained is the drainage system. Gutters, drains and downspouts together form the system that collects and carries away water from roofs. They are most often made of metals such as aluminum, copper, galvanized steel, stainless steel or cast iron. One way to detect possible problems is to find stains, mildew, moss or rotting of the building surface adjacent to gutters and downspouts.

The CAP Program

Frequently, what school districts are lacking is a program by which they can systematically evaluate building components. To meet this need, the New York State Department of Education (NYSDE) has implemented a unique system called the Capital Assets Preservation (CAP) program. The program enables state educational administrators to make projections for facilities management over the next five years and to deal with capital planning for over 8,000 aging public school buildings in New York state.

The CAP Program, as developed by WASA, established a prescribed set of procedures and actions to routinely check and evaluate all building components. Part of the program consists of a projection technique to plan capital spending efforts. School administrators and custodial staff are provided with a manual and checklists so they can compile and submit inventory information for tracking and evaluating the condition of building components. Local school district officials then use the data to analyze and compile comprehensive facilities planning and budget information which in turn is submitted to the state education department using the software program developed by WASA for presentation to the legislature for the proper allocation of funds.

An example of a NYSDE CAP Program Building Component Checklist is on page 16. It establishes the criteria for evaluating a roofing system on a component by component basis, and for recording any preservation actions. The information is extremely useful for each individual school in keeping track of component conditions and corrective actions.

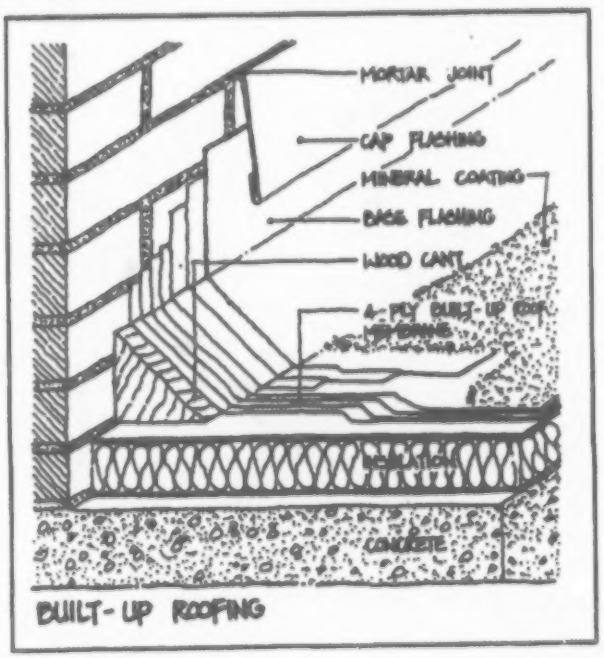
The CAP Program may soon be used by New York City's School Construction Authority (SCA), an independent agency that is responsible for rehabilitating the city's facilities. One of the agency's chief tasks involves re-roofing. The CAP program has been an effective tool for school custodial staff in assessing the many different types of roofing systems that exist.

Condition Assessment

Using the checklist, a school engineer or custodian can take the first step towards evaluating and preserving the roofing system. Even with no apparent problems, an assessment should be performed as a preventive measure. Start a year before to look at the roof and keep good records of what is seen. Include repairs that have been made over the years, the age of the roof and the materials used. Check the compatibility of patching materials.

If it appears that the roof needs to be replaced or repaired, it is time to call in an architect to perform a condition assessment (CA) and to develop contract documents. The CA is an assessment of the total system and the parts that make up the environment of the roof, including the surrounding walls, membrane, flashing, drainage system and insulation. All of this information will eventually become the basis of contract documents.

The decision to leave the existing membrane intact and to reroof over it, a less costly alternative, will be up to the profes-



BUILT-UP ROOFING

sional's judgment. The condition of the roof will determine whether a tear-off is required.

The architectural professional is responsible for the methods used and the materials selected. He performs an assessment and prepares contracts, specifications, and construction documents. He reviews the bids and helps to select a roofing contractor. He may also oversee and inspect the construction and monitor payments to the contractor.

Testing for Asbestos

In scheduling a reroofing project, state and federal laws require that the roof be tested for asbestos. If asbestos containing material is found, it will undoubtedly add complexity and cost to the project.

The proper way for the user to approach the problem is to have the roof tested by a certified asbestos consultant who takes an appropriate number of samples of roofing material and base flashing. The cost of asbestos removal and disposal could add as much as 30 percent or more to the cost of the project. Part of this is the cost incurrec for the preparation of special documents that are required for the legal removal and disposal of the asbestos containing materials.

Cost, Guarantees & Insurance

Contractors and manufacturers who bid on the job should have at least five years of roofing experience. The bids will depend on the scope of the work. When a conventional tear-off and reroofing is required, the job will cost approximately $10-$12 per square foot.

Elementary schools usually range in size from 20,000 to 50,000 square feet. Given a 20,000 square foot facility, the roof would measure 5,000 square feet. If, let's say, the BUR was totally saturated and a tear-off was necessary, the cost would be $50,000. If asbestos containing material is found, the cost as stated above would be significantly more.

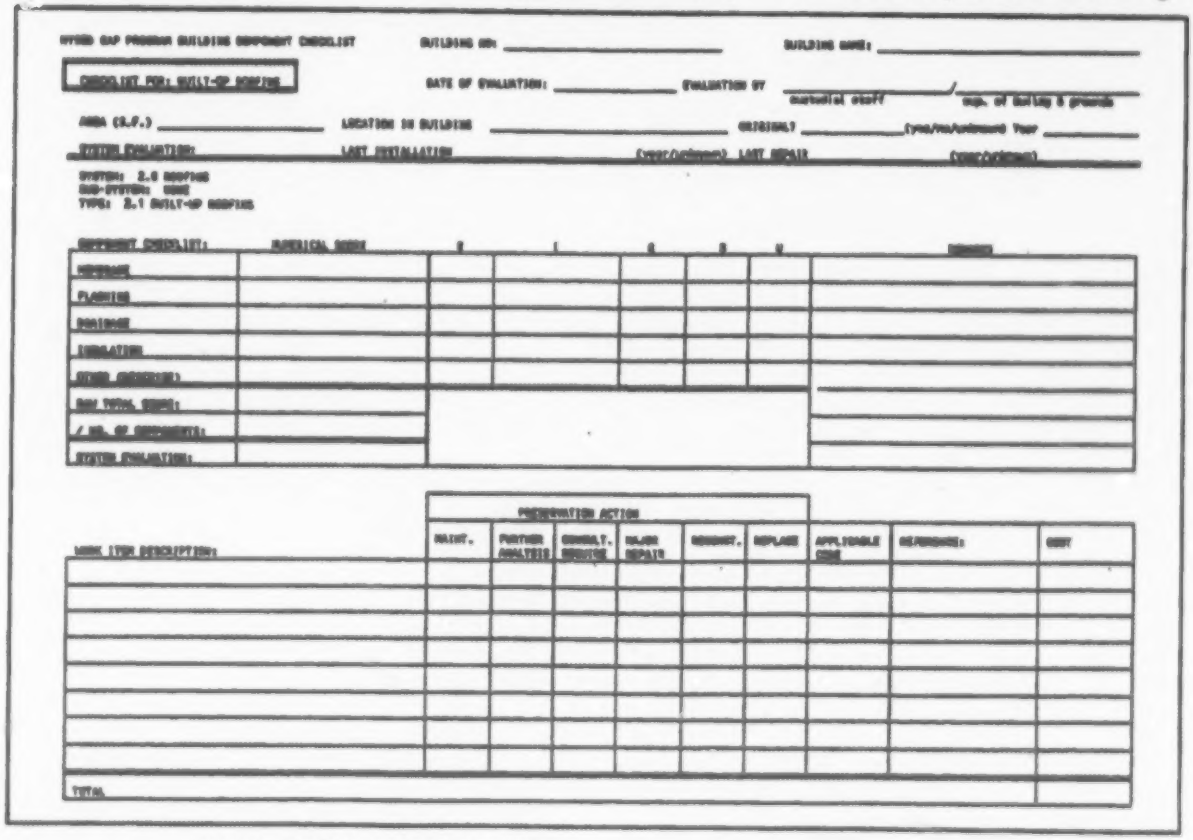
Intermediate and junior high schools are generally 60,000 to 100,000 square feet in size; high schools are generally 90,000 to 150,000 square feet, with the roof measuring one-quarter of the total square footage of the facility.

When it comes to guarantees and insurance, the architect should make sure they are both stipulated in the documents before the final payment is done. Prohibitions for use of the roof and maintenance of the roof should also be stipulated. When a new roof is installed the school administrator is entitled to a maintenance manual outlining the "dos and don'ts." The manufacturer should also provide bi-annual return check-up services to make sure the roof is intact. This service should be included in the contract.

Nondestructive Testing Methods

In addition to visual assessments, there are other nondestructive ways to test your roof to determine if any leaks are developing. These methods are of particular value when it comes to assessing very large facilities.

New moisture detection methods rely on external readings



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from wet insulation without removal or destruction of any part of the roof structure. Non-destructive moisture detection devices are most appropriate for preventive inspections or for determining the extent of isolated leaks.

The first technique, nuclear moisture detection, works by indicating the presence of hydrogen atoms, which are found in water. The second detection method which can be used with any type of insulation is the capacitance method. This technique is based on the concept that different materials have different dielectric constant characteristics; that is, they differ in the extent to which they are nonconductors of electric current.

The third detection method, infrared thermography, can be used only on fiberglass or fiberboard insulations. This technique measures energy, or heat, which is emitted from "hotspots" in the roof. Since wet insulation conducts more heat than dry insulation, hotspots indicate the presence of water in the roof.

Where it is clear that water damage is widespread and substantial, it may make more sense to initiate remedial measures immediately than to spend time and money implementing one of these tests. However, large facilities that maintain many thousands of square feet of roofing could find the new techniques helpful in catching problems before they are out of hand, thereby reducing repair costs and heat loss.

Preparing for Construction

Once the CA is completed (including any necessary tests, the construction documents and bid) you may finally be ready for construction. The best time to begin the messy repair operations is at the beginning of the summer immediately following the exodus of the students. With proper planning and the assistance of a qualified architect to observe the work, the job of reroofing a typical school building should take approximately two to four months to complete.

In order to finish the job in time for the opening of school, a tight schedule must be adhered to. Contract documents should be timed so competitive bidding can occur. Allow two weeks for this to occur and another two to three weeks for contract execution. Mobilization, actual site preparation and material delivery can start a week after the normal summer recess begins. If some completion work does extend past the start of the school year in the fall, it will have minimal impact on school activities.

As you can see, the key to prolonging the life of a roof is through a carefully planned maintenance program. Like learning, preservation must be an ongoing activity as neglect will only result in deterioration that is more difficult to reverse.❑

Robert Napier and Hazel Ephron are partners in New York City-based Wank Adams Slavin Associates (WASA), an architectural, engineering, and preservation firm active in planning and designing school projects.

Criteria for Evaluation of Sub-System: Built-Up Roofing

Unsatisfactory – Replacement
(beyond repair, must be replaced)
- Age 15 years or more
- 50% or more roof deterioration and age 10-15 years
- Leaking throughout ceiling and age 10-15 years

Satisfactory – Reconstruction
(adequate for the present but needs major repair and continuous maintenance)
- 25-50% roof deterioration and leaks evident in ceiling
- 50% or more of base flashing deteriorated
- 50% or more of cap flashing displaced or deteriorated
- 50% or more of gutters, valleys, and leaders deteriorated

Good – Major Repairs
(in working order, some repairs required and may need additional maintenance)
- 25% or less roof deterioration or leaks evident in ceiling
- Less than 50% of base flashing deteriorated
- Less than 50% of cap flashing displaced or deteriorated
- Less than 50% of gutters, valleys, and leaders deteriorated
- Rusting, damaged elements penetrating roof (fans, vents, skylights)
- Open seams in flashing or roof surface
- Cracked, open sealant joints (at expansion joints; above cap flashing)

Indeterminate – Consultant Required or Further Analysis
- Professional inspection
- Probes or testing required
- Summary report required
- Drawings and specifications required

Excellent – Maintenance
- No work required
- Normal maintenance required

Twenty Questions to Ask When Buying a Roof

By Bruce R. Wilby

With over 200 roofing systems on the market today, selecting the best roofing system to meet your needs can be an overwelming task. The fact that over 75 percent of all building litigation is roofing-related only underscores the importance of making the right roofing decision. Where should a school business official start? How can you weed through the promotional jungle in order to determine which roofing system is right for your building? One way is by asking the following questions.

1. *Is the UL label displayed on all roofing material delivered to the job site?*

It should be. This is the only way to guarantee that the roofing materials installed on your roof are the same materials tested by Underwriter's Laboratories. Displaying the UL label in a promotional brochure does not mean the same thing — it only means that one specific sample of that product met certain UL standards. However, if the UL label appears on the product or product packaging, that means that *all* products bearing that label are consistent with those product samples tested by UL.

You should also double check that the roof assembly, which includes the insulation and deck, is also UL classified and labeled. If you use an insulation other than the one tested with the roofing membrane, you may void the UL classification.

One way to confirm a roofing system's UL classification is by checking in the UL Building Materials Directory. If the roofing system you are buying is not listed in the directory, then insist on seeing a photocopy of the UL's letter of approval for verification of the classification.

2. *Does the system pass the Factory Manual I-90 Wind Uplift Test?*

Wind uplift damage can be extensive and expensive, so select a system which does well on this test, a basic industry standard.

3. *How much weight does the total system add to the dead load weight of the roof structure?*

Certain types of reroofing systems can adversely affect the load bearing capacity of your old roof deck. By the same token, you can save on structural steel costs in new construction by using a light weight single-ply. Look at these comparisons: a four-ply built up roof with gravel weighs approximately six pounds per square foot. A PVC of EPDM roof with ballast can weigh up to 10 to 15 pounds per square foot, while a mechanically attached single-ply system weighs approximately one-third of a pound per square foot. Lighter systems can often be applied directly over an old roof, whereas the heavier systems usually mandate an expensive tear-off.

Your questions should also focus on the roofing manufacturer. Some questions to ask are as follows:

4. *Does the company actually manufacture the system, or are they just a marketer?*

Manufacturers tend to have more experience and technical staff than marketers, so they can offer better support and faster responses to questions or problems. They also have more of a commitment to the business.

5. *How long has the company been in the business?*

Beware of fly-by-night operations which might disappear at the same time the roof starts leaking. Instead, look for a reliable, stable firm with a good name and reputation in the industry.

6. What is the company's net worth?

Look for a company with the financial stability to stay in business and back up its warranty.

7. Can the company supply a list of references (preferably installations which mimic your situation)?

A company's product may be perfect for one situation, but not acceptable for a different application. For instance, one roofing system may have a reputation for resisting wind-uplift damage, but an inferior record when it comes to withstanding the sun's ultraviolet rays. If your building is in a sunny climate, you'd want to take this into account before making a roofing decision. That's why its important to find references with similar features, climate, occupants, etc.

The roofing contractor also should be carefully considered. Don't be afraid to ask:

8. What is the financial strength of the contractor?

Under the terms of many warranties or manufacturer's applicator agreements, the roofing contractor is liable for defects in workmanship during the first two years of the warranty term. Therefore, it is important to reassure yourself that the contractor will remain in business and will be able to financially weather any claims made against the company by the building owner or roofing system manufacturer.

9. Has the contractor been certified and trained to install the roofing system you've selected?

Roofing systems can vary tremendously in how they are applied, so it is important that the contractor have experience in installing the roofing system you've chosen. A good rule of thumb is that the contractor should have installed at least 100,000 square feet of that system in the past 18 months.

10. Are there enough certified applicators in your area to provide you with competitive bids?

You don't want to be at the mercy of someone who has no competition and can, therefore, charge as much they want.

If there is a problem with the roof after it is installed, you'll want a strong warranty to fall back on. Find out as much as you can about the warranty by asking:

11. Who issues the warranty?

The warranty could be issued by the roofing manufacturer, the roofing supplier, or even a contractor. Whoever it is, make sure that they have the financial resources and intention to service and honor the warranty in the years to come.

12. Who backs the warranty?

Is it a manufacturer or perhaps an insurance company? The roofing manufacturer is a preferred party, because they have the most vested interest in wanting to keep the customer happy.

13. Does the warranty cover the entire system — or just the membrane?

While small items, such as fasteners, fascia, and insulation may not seem like big-money items, repairing or replacing them can be labor-intensive — and thus expensive. Know in advance what parts of the roofing system are covered by the warranty to avoid expensive surprises later.

14. Does ponding water void the warranty?

It is virtually impossible to avoid all ponded water — which can be caused simply by a clogged roof drain or deflection of the roof deck in between the support beams. Beware of warranties which include this exclusion.

15. What are other warranty exclusions?

As a general rule, the longer the term of the warranty, the less it covers. Therefore, it is important to consider how many exclusions the warranty has, since exclusions are the limitations of the warranty. Some exclusions to question include:

- Gale force winds — The Beaufort Scale lists four levels of gale force winds, which range anywhere from 32 to 63 miles per hour. Find out the manufacturer's miles per hour definition of gale force winds.
- Environmental fallout — This could mean anything from acid rain to snow. Determine, in writing, specifically what the term means.
- Undefined substrate movement — All buildings expand and contract, and a good roofing system is flexible enough to accommodate this movement. Thus, this exclusion could give the manufacturer a loophole to use later on.

16. How thick is the roofing membrane?

A few millimeters in thickness can make a substantial difference in durability — and cost. Therefore, if one system manufacturer's price is significantly lower than another's, make sure the membranes are of the same thickness so that a fair comparison can be made.

17. What is the chemical resistance of the membrane (or base polymer)?

Determine what chemicals may be vented onto the roof, or what airborne chemicals can be expected in your geographic area. Then be sure that the membrane you are considering will withstand the concentrations of those chemicals that can reasonably be expected to accumulate on your roof.

18. How well does the membrane weather?

The Midwest Roofing Contractors Association has approved the EMMAQUA Accelerated Weathering Test as a preferred means of estimating the life of the membrane over time. One reason is because this method uses actual sunlight and exposes the membrane to the full range of the sun's destructive ultraviolet radiation. Ask how many Langleys — the standard unit of measurement for the EMMAQUA Test — the roofing system has endured without

cracking, stiffening, or discoloration. A bare minimum is two million Langleys; three million is a more realistic standard for comparison.

19. Does the roofing system contain plasticizers?

Usually membranes containing plasticizers must be covered with ballast or coated to prevent exposure to ultraviolet radiation. The migration of these plasticizers can leave the membrane stiff and brittle — just like a vinyl shower curtain which deteriorates over time as the plasticizers leech out.

20. What is the membrane's dimensional stability?

As we mentioned earlier, a roofing membrane should be able to expand or contract with the building. However, don't be too impressed with large percentages of expansion. If your building expands to 50 percent or 100 percent of what the membrane is capable of, then the roofing system is the least of your worries.

Instead, pay more attention to the contraction percentage — since that's what can cause the real damage. Is the membrane prone to shrinkage? — even one percent can cause movement of one foot in a 100 foot building. This is enough to precipitate a roofing system failure. Look for dimensional stability in low fractions of a percent.

Selecting a roofing system can be a complicated and confusing task. However, knowing what questions to ask can lead to a more educated decision, which in turn should result in a roofing system that is a good match for your needs and your building.□

Bruce R. Wilby is Business Manager at Stevens Roofing Systems Division, JPS Elastomerics Corporation, Northampton, Massachusetts.

Selecting a Roof Membrane

By Larry W. Waldron, RCI

The decision to reroof a building is most often made once the aggregate sum of manhours, money, and aggravation has reached an intolerable level. In the most extreme cases, the decision is not made until the waterproofing integrity of the old roof has been completely compromised resulting in a total loss of insulating value underneath, and possible damage to the roof deck and the building interior.

Whatever the reason, and regardless of the stage of neglect the old roof is in, the decision to commit a large sum of money to the purchase of a new roof is one that is difficult for most building owners and financial administrators. Once the decision to reroof is made, however, a series of other issues must be addressed and additional decisions made.

Possibly the most important subsequent decision is the selection of a roof covering membrane to be installed in the new roofing system. In fact, the selection of a new roof membrane is so crucial to both the short- and long-term success of the reroofing project, that some building owners and financial administrators hire the services of outside consultants to perform the project evaluation and membrane selection process. Others have in-house staff capable of collecting and analyzing the technical data necessary to select the best roof membrane for the building to be reroofed.

It is generally accepted by most roofing industry professionals that no one roof membrane is right for

all building roofs. In many cases, however, there may be several roof membranes that would perform equally well in the same environment.

In truth, it may well be that the reason so many new roof membranes have been successfully introduced to the market place over the past 20 years is that each technological difference between membranes is an attempt to address a perceived or real weakness in the performance or cost of a competing product. Owing to the technology explosion that has occurred in the roofing manufacturing industry in the past two decades, the number of choices available to the building owner and administrator has become confusing for some.

This article is written in an attempt to alleviate some of the confusion spawned by the growing number of roofing membranes and to assist the school business official in developing a methodology for selecting the best roof membrane for his or her reroofing project. No article, or even a single book, can address all of the unique considerations for all roofs, however, it is hoped that this piece will be useful to the reader as a handy reference guide during the membrane selection process.

The principal categories for roof membranes currently utilized in reroofing are listed in Table 1. All of the various membrane types and permutations have certain chemical and other characteristics that affect their performance in certain applications. Each one has specific strengths and weaknesses as a roofing membrane. There are numerous manufacturers of the membrane types listed in the single-ply category and several manufacturers in the other categories. The bulk of the technological experimentation over the past 10-15 years has been in the elasto-plastic (single-ply) category as evidenced by the sheer number of chemical variations available.

This is not to say that manufacturers of other membrane types have not been searching for ways to improve upon their existing product lines. In fact, manufacturers involved in the production of built-up roofing materials have made several technological changes in the "grandfather" of roof membranes. Some of these changes include the development of glass fiber roofing felts, a low-fume coal tar, polymer extended asphalts, and various improvements in flashings.

The following roof membrane profiles are offered as a brief synopsis of the unique characteristics of each.

Built-Up Roofing

This type of roofing system historically used either organic felts or asbestos felts with multiple plies, in four-ply systems, and in some cases three- or five-ply. A relatively recent development in the production of reinforcing felts was the change to the use of fiberglass mats in place of the older type felts.

At this time it is estimated that fiberglass has 85 percent of the market share in built-up roofing. The balance uses organic felts or polyester mats. The fiberglass felts used today surpass the physical properties of rag and asbestos felt systems of the past. Consequently, some built-up roofs today use a three-ply configuration of glass felt, compared with four or five piles of the other felts. Fiberglass membranes more uniformly resist stress in all directions and have a resistance to degradation by moisture.

Inner-ply moppings of hot bitumen provide the waterproofing agents and adhesive properties of the system. They arrive at the site in solid form, but are heated and applied as liquid. Bitumens are either a product of petroleum refining asphalts, or a product of the coking process of coal – coal tar pitch.

Some built-up membranes are left with a smooth surface, or just a final mopping of bitumen. A light colored surfacing material such as aluminized coating can be applied to help reduce the summer heat gain. Fire ratings may have to be considered. Many BUR membranes are gravel surfaced, which affords fire protection, weathering protection, and mechanical protection to the membrane itself.

Hot application BUR. Hot application BUR is generally referred to by bitumen type and number of plies, e.g., a four-ply asphalt BUR or a four-ply coal tar BUR. The primary performance characteristics that differentiate the two types of bitumen and tend to aid in the selection of one over the other are as follows:

- Asphalt is generally considered

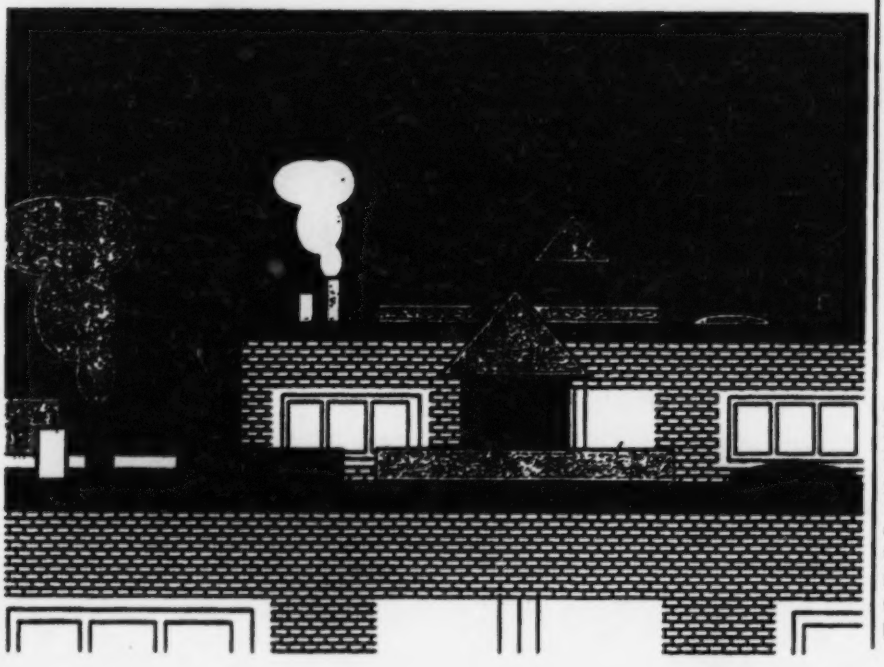

TABLE 1
Principal Roof Membrane Categories

A. Built-up Roofing (BUR)
B. Elasto-Plastic Membranes (single-ply)
C. Modified Bitumen Membranes
D. Liquid Applied Membranes
E. Metal

Each of these principal roof membrane categories is further subdivided by technological differences:

A. Built-Up Roofing (BUR)
   1. Asphaltic-based
   2. Coal tar-based
   3. Cold process BUR
B. Elasto-Plastic Membranes (single-ply)
   1. Thermoset Elastomeric (rubber) membranes
      a. EPDM – Ethylene Propylene Diene Terpolymer
      b. Neoprene – Polychloroprene
      c. CSPE – Chlorosulfonated Polyethylene "Hypalon"
   2. Thermoplastic Membranes
      a. PVC – Polyvinyl Chloride
      b. CPA – Copolymer Alloy (PVC Alloy)
      c. EIP – Ethylene Interpolymer (PVC Alloy)
      d. NBP – Nitrile Butadiene Polymer (PVC Alloy)
      e. CPE – Chlorinated Polyethylene
      f. PIB – Polyisobutylene
C. Modified Bitumen Membranes
   1. APP – Atactic Polypropylene
   2. SBS – Styrene-Butadiene-styrene
D. Liquid Applied Membranes
   1. Silicones
   2. Urethanes
   3. Acrylics
   4. Hypalons
   5. Neoprenes
E. Metal Roofing
   1. Galvanized Steel
   2. Aluminum Coated Steel
   3. Aluminum-Zinc Coated Steel (Galvalume)
   4. Aluminum Sheet
   5. Copper
   6. Other Metals

the better bitumen for BUR membrane construction in geographic regions typified by long, cold winters and mild or brief, hot summers. Asphalt is also more capable of withstanding greater daily temperature extremes is than coal tar.

■ Coal tar is generally regarded as the better bitumen for geographic areas having long, high-heat summers with mild or short-duration, cold winters. Coal tar is less sensitive to intense sunlight and/or ponding water situations than asphalt.

■ Coal tar is essentially limited to roof slopes of 1/4 inch or less without special treatment and requires the application of an aggregate surfacing in most cases.

■ Asphalt, depending on grade or type, can, under proper specification and design, be utilized on slopes up to 6 inches.

Cold Process BUR. Cold process BUR construction is sometimes used. Solvents are used to liquify and carry the asphalt bitumens without heat, or a water-based asphalt emulsion is used. Most cold process roofing is used as a recover operation.

Development of different polyester fabrics occurred in the early 1980s. These fabrics have the ability to elongate and drape over uneven substrates, which a fiberglass sheet will not do as well. One or two plies of polyester along with a cold process bitumen have served to prolong the life of existing BURs.

The surface preparation of an existing BUR is critical to the success of the cold process system. All blisters must be removed as well as loose gravel or other surface debris.

Various surfacing materials may be used with a cold process roof including gravel and ceramic granules. Cold process BURs must be allowed to set-up before foot traffic occurs. The advantage of a cold process system is that a kettle is not needed at the job site; a disadvantage is, that once applied, foot traffic has to be kept to a minimum until the cold process bitumen loses the solvent, or the emulsion dries thoroughly. Cold process roofing normally utilizes a flashing system which is dependent on cold adhesives for its integrity.

Elasto-Plastic Membranes

Unlike BUR, which has been used on low-slope roofs since about 1850 or before, the elasto-plastic family of single-ply membranes first started showing up on roofs in the United States around 1970. Various surveys of market share for roofing products indicate that this generic family of single-ply membranes account for approximately 50 to 53 percent of roof coverings sold annually.

Thermoset Elastomers (EPDM, CSPE, Neoprene). This group of single ply membranes is also referred to as "non-weldable." This nomenclature stems from the fact that the elastomeric or rubber-like properties are "cored," "vulcanized," or "chemically cross-linked" into the sheet such that they require an adhesive to mate two pieces of like material and cannot be heat fused together.

These materials have both elongation and memory properties.

These properties allow the membranes to stretch or extend and then return to their original size, shape and dimension. Having both elongation and memory makes these synthetic rubber membranes highly useful for roof applications where thermal or structural induced movement is known to be a problem.

The principal weakness of these products has generally been the ability to achieve consistency in seaming quality and flashings. Much of this criticism, however, has been a function of workmanship error that brought about the premature seam failure. Advances in adhesive formulations and seam construction techniques have lessened the rate of seam failures considerably in the past 5-7 years. These roof membranes are generally installed in one of three methods: ballasted, mechanically attached, or fully adhered.

One notable exception to the "non-weldable" designation for this family of membranes is CSPE or Hypalon. This membrane is shipped to the job site in an uncured state allowing the installer to heat fuse or "weld" the sheets together. Natural aging or exposure to heat will eventually cause the CSPE membrane to cure, resulting in a roof membrane that can only be seamed, patched or repaired utilizing an adhesive to achieve a bond between pieces of like material. Further, once cured, a piece of uncured new material cannot be welded to a cured piece of aged material. This aspect of CSPE is often considered one of its weaknesses from a maintenance or repair perspective. Additionally, it is important to be certain that CSPE materials shipped to a roofing project are very recently manufactured and not stored in direct sunlight or high heat environments for extended periods of time.

Thermoplastic Membranes (PVC, CPA, EIP, NBP, CPE, PIB). This group of roofing membranes are also referred to as "weldable" single-plys. This term means that the properties of the membrane are such that through the use of directed heat two pieces of like material can actually be fused or "welded" together. Thermoplastics can also be molded or reshaped through the use of heat.

Of the thermoplastic roofing membranes, polyvinyl chloride (PVC), or derivatives of PVC, are generally regarded as having the greatest market share. The membrane known generically as PVC is often recognized as having been the first of the chemically produced single-ply membranes to gain high usage in the United States for roof covering applications. PVC is available in many colors and can be obtained in both reinforced or unreinforced configurations. Field seams or splices can be made with either heat or solvent welding techniques.

Generally, PVC and its multiple alloy combinations (CPA, EIP, NBP) all have high puncture resistance owing to the inclusion of a reinforcing fabric. Generally, this fabric is a polyester mat which reinforces and has a reasonably high resistance to the ill-effects of ultra-violet (UV) and ozone exposure. The PVC family of membranes are resistant to most chemicals, but are dramatically affected by oils.

Chrolinated polyethylene (CPE) roofing membranes are generally produced with a polyester mat reinforcement. The unreinforced CPE material is used for roof system flashings. This material is available in white and is normally installed utilizing fasteners to the roof deck which are incorporated into the roofing sheet seams. This is commonly referred to as a mechanically attached configuration. Like other thermoplastics, it can be heat- or solvent-welded together although it tends to be more difficult to weld than the plasticized PVC membranes.

Polyisobutylene (PIB) roofing membranes represent somewhat of a departure in technological or chemical approaches from the thermoplastic membranes discussed thus far. PIB that is used for roofing was developed in Germany around 1950 with other uses of PIB dating back to the 1930s.

PIB is an uncured elastomer that has similar field use characteristics as the uncured thermoset elastomers, yet is a member of the thermoplastic chemical family. PIB roofing membranes have historically been produced in a 60 mil thickness of PIB laminated to a polyester backing or matting. The rolls are normally produced in 36-inch widths and the seams are sealed using unbacked PIB tape, or uncured selvedge contact. The membrane is predominately installed and secured to the substrate with hot asphalt, however, recently some manufacturers have promoted its use in ballasted configurations. PIB is sensitive to solvents, organic oils, fats and coal tar pitch. PIB roof membranes are generally rather expensive in comparison with other single-ply membranes, but because the manufacturers will allow them to be installed directly over a properly prepared asphalt BUR, this membrane can be a serious cost saver in certain applications.

Modified Bitumen Membranes

While often categorized as single-ply membranes, these products deserve their own category. These membranes are normally installed on a roof utilizing at least one ply of fiberglass base sheet over the insulation, thus the completed assembly would have at least two plies of material over the insulation. So much for categorization.

Modified bitumen contains a base asphalt selected by the manufacturer for its compatibility with the polymer modifier intended to be used. Currently, there are two broad categories of modified bitumens, using either APP or SBS polymers.

Atactic polypropylene, or APP, is a thermoplastic additive first used in Europe. Styrene butadiene styrene, or SBS is also used to modify asphalt flux; SBS imparts elastic properties to the bitumen.

Modified bitumen membranes are made with one or sometimes two reinforcement sheets normally contained near the center. Fiberglass scrim sheets may be used as reinforcement, offering good tensile and stiffness properties to the modified bitumen sheet. Non-woven polyester fabrics ranging in weight from 100 to 150 grams per square meter are also used as reinforcement in modified bitumen sheets. Non-woven polyester offers very high elongation and

good puncture resistance to the modified bitumen product.

Modified bitumens also have two common installation techniques, torching and mopping. APP modified bitumens have a high melt point, normally between 260 and 300 degrees fahrenheit. Propane torches are used to achieve surface melting of the material. Usually, a multiple-head wheeled applicator wagon is used to lay and fully adhere the sheet. A single-head propane torch is used to heat-weld the side laps and the flashing details. Flameless heated anvil welders are also used.

APP modified bitumens are normally unsurfaced, but can have a factory applied foil or mineral surfacing. Coatings can also be field applied, or a pour coat of bitumen and gravel is sometimes used.

SBS materials are normally set in moppings of hot asphalt, similar to BUR membrane construction, but are occasionally torched or cold applied. The softening point for SBS modifiers normally ranges from 240 to 260 degrees fahrenheit. A bleed line of hot asphalt should be visible, indicating that enough asphalt adhesive was available for making the side lap.

SBS membranes are flashed in a manner similar to BUR. SBS materials need to be protected from direct sunlight; they are normally produced with a granule or foil surfacing. Gravel surfacing may also be used.

Liquid Applied Membranes

Generally, this family of synthetic membranes are utilized as a coating applied over "sprayed in place" polyurethane foam. In polyurethane foam roofing applications, the spray foam is designed to provide the insulation and application substrate for the weather-resistant liquid-applied membrane. These membranes have been chemically formulated to provide similar characteristics as the single-ply sheet membranes once they have dried or cured in place.

The coatings protect the foam from U.V. degradation and provide an elastomeric weathering surface which also serves as a vapor barrier.

Each of the liquid membranes produced for use over polyurethane foam has certain unique design strengths and application limitations. One principal common element in the majority of the liquid membranes is that they are solvent based. Environmental and other considerations relative to the aromatic solvent fumes should be reviewed prior to selecting a specific liquid membrane or spray urethane foam coating.

Water-based coatings or membranes do exist, but they are more sensitive to temperature constraints during application than the solvent-based membranes, and they are more readily effected by water puddling or ponding.

Metal Roofing

While numerous configurations of metal panel construction techniques have been employed in roof covering approaches, the structural standing seam roof (SSR) is the most common today. Metals of various types and gauges have been employed for some time in what is referred to as steep slope roofing. It has proven to be an excellent roof covering when properly designed and installed. Ferrous metal roof panels, fasteners, and flashings do, however, require a coating to act as a weather-resistant surfacing to prevent oxidation or rust. These coatings on ferrous metals normally last 5-10 years before requiring complete recoating, however, annual inspection and coating touch-up is highly recommended.

Development of the structural standing seam metal roof as used today began in the 1960s. Although today's structural standing seam roof systems differ from each other in detail, they typically contain the following elements:

Structural supports, called purlins or sub-purlins depending upon the roof structure beneath them, are usually located on 5 foot centers. Concealed clips are fastened to the purlins; they support and retain the roof panels, but allow them to move longitudinally, thus accommodating thermal movement.

The roof panels, in the form of shallow metal pans, are joined with concealed fastening systems above the plane of the panel itself. The side seams are thus elevated out of the water drainage plane.

Various kinds of fasteners are used to hold the system together. Usually, but not always, some form of thermal insulation is used, as well as various joint sealants and flashing accessories.

Besides the elevated seam, another characteristic which separates the structural SSR from other forms of roofing and even most older types of metal roofing is that the SSR panels are self-supporting between the structural members, needing no deck beneath them for support. The membrane and the deck are one and the same.

The structural standing seam roof is appropriate not only for pre-engineered buildings, but for ordinary or conventional construction as well. However, roofs with large numbers of penetrations and/or a lot of rooftop equipment can present difficulty in flashing and seaming a metal roof.

An important factor in roof weathertightness is the rib and joint design of these systems. A number of joint designs are in use. Some systems use doublelocked seams, like those in steel drums, others simply bend an edge around an adjacent edge to clamp panels together or snap on a batten cover. There is some variation in the effectiveness of these systems.

CONCLUSION

In an effort to assist the reader in understanding some of the advantages and disadvantages of the various roof membranes addressed in this article, a generalized chart of the raw membrane characteristics has been prepared (see Table 2). This chart attempts to compare the characteristics of the raw membranes only, without regard for additional coatings, surfacings, or modifications that would alter a specific characteristic or enhance the use of the membrane.

For example, BUR membranes are rated low on fire resistance in the chart, but with a fire retardant

TABLE 2

RAW MEMBRANE CHARACTERISTICS

MEMBRANE TYPE	Elongation Capacity	Memory Capacity	Thermal Resistance	Ultraviolet Resistance	Fire Resistance	Puncture Resistance	Tear Resistance	Chemical Resistance	Oils Resistance	Slope Restriction
Built-up Roof Asphalt	1	1	2	2	1	3	3	3	1	2
Built-up Coal Tar	1	1	2	3	1	2	3	3	2	3
Built-up Roof Cold Process	2	1	3	2	3	3	3	3	1	2
Single Ply EPDM+	3	3	3	2	1	1	2	2	1	2
Single Ply Neoprene*	3	2	3	2	1	1	1	2	3	2
Single Ply CSPE (Hypalon)*	2	2	3	3	3	2	2	2	2	2
Single Ply PVC*	2	1	3	2	3	3	3	3	1	1
Single Ply CPA*	2	1	3	2	3	3	3	1	1	1
Single Ply EIP*	2	1	3	3	3	3	3	2	2	1
Single Ply NBP*	2	1	3	3	2	3	3	2	1	1
Single Ply CPE+	3	1	3	2	3	2	2	3	3	1
Single Ply PIB*	3	1	3	2	3	2	2	1	1	1
Modified Bitumen APP	2	1	1	1	1	2	2	2	1	2
Modified Bitumen SBS	3	3	3	2	1	2	2	2	1	2
Liquid Applied Silicon	2	1	2	3	1	1	1	2	2	1
Liquid Applied Urethane	3	3	2	1	2	2	1	2	1	1
Liquid Applied Acrylic	1	1	2	1	2	1	1	2	3	1
Liquid Applied Hypalons	2	1	2	3	3	2	2	3	3	1
Liquid Applied Neoprene	3	1	3	2	3	1	1	2	3	1
Metal (Galvanized Steel)	1	1	2	3	3	3	3	2	3	3
Metal (Aluminum/Steel)	1	1	2	3	3	2	3	3	3	3
Metal (Aluminum)	1	1	2	3	3	2	2	2	2	3
Metal (Copper)	1	1	3	3	3	3	3	2	3	3

1 = Low; 2 = Moderate; 3 = High; * Based on reinforced membrane; + Based on unreinforced membrane.

Note: This chart is not intended to endorse any product or manufacturer but merely to illustrate the range of materials available and some of their various properties. It is not in any way a complete listing of products available, or intended to replace thorough research by the specifier of available systems and materials. Due to the rate of product development and improvement in the single-ply market, entries may be superseded.

coating, or proper amounts of aggregate surfacing, the assembly can provide an excellent resistance to fire. This would, however, be a measure of the fire resistance of the coating or aggregate surfacing, not of the membrane alone. It should also be noted that while the generic category of each membrane type demonstrates a strength or weakness in a given characteristic in the chart, various manufacturers may have developed a variation in their base product formulation to alter this characteristic.

The selection of a roof membrane is much more involved than just picking the one that has the cheapest price or has the highest elongation property or some other single attractive characteristic. Other selection parameters include: structural support system, the roof deck type and condition, wind uplift considerations, insulation types and thicknesses, compatibility of materials, rooftop traffic, potential for vandalous activity, and many other purely technical considerations, as well as the practical aspects of total roof system affordability.

While this article has attempted to assist in sorting out some of the differences in roof membranes and their characteristics, there is no substitute for time spent acquainting oneself with as much factual data as possible about the various choices available. In fact, the best place to start evaluating the new roof membrane is through analysis of the past performance of the existing one. Knowing as much about the shortcomings of the existing roof membrane and why it may have prematurely failed is an excellent base to spring from in selecting a new roof membrane. Finally, many of today's roof membranes were born out of space-age technology and much has changed over the years, but a healthy dose of common sense and a little research will go a long way toward helping to pick the right roof membrane for your facility.❑

[*Editor's Note:* Much of the research for this article was provided by articles and fact sheets from the Roofing Industry Education Institute (RIEI) in their Re-roofing Options seminar manual. For additional information on roof membrane systems and the multiple factors influencing a selection decision, the Roofing Industry Education Institute is an excellent unbiased source.]

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Roofing Warranties
The Perils of Long-Term Promises

By Stephen R. Mulvihill, AIA, CPRC

Before syndicated columnist Mike Royko went on a recent vacation, he wrote another of his "occasional and slightly weird" features on readers' gripes. While his readers voiced many pet peeves from "milk cartons that say 'Open Here' but don't" to "Itchy-scratchy clothing labels," (Sept. 7, 1993) they missed those that trumpet the plight of the lonely, frustrated building owner trying to fix the leaks in his warranted roof. Several entries for the 1994 series of gripes are:

- The contractor's invoice that shows up for service contract work that you thought others were paying for;
- The warranty service contractor who damages your bushes (Try to collect $100 from anyone with no retainage);
- Dialing the manufacturer's phone number connects you to an answering machine that ends the message with "Have a nice day!"

These are a sampling of the widespread owners' frustration with the performance of their ten-year-old roof systems and with manufacturer repairs that temporarily stop leaks, that do not correct fundamental (and expensive) problems, and that become the owners' full responsibility after the termination of the warranties.

Good quality roofs should last twenty years before they seriously split or crack. Roofs lasting five, ten or fifteen years are considered short horizon or speculative and are not of institutional quality.

Last decade's proliferation of roofing systems spawned a deluge of confusing and misunderstood warranty documents, whose unsatisfactory enforcement has surprised many unwary building owners. Even industry professionals express difficulty in tracking warranty agreements that subtly, but significantly, change from year to year.

Various warranties and common remedies are available to the roof-system purchaser. The four main remedies are:

- The Uniform Commercial Code
- The construction-claim statutes
- The roof-contractor guarantee
- The manufacturer warranty.

Uniform Commercial Code

In the absence of a precedent manufacturer's warranty, the owner has rights and remedies against the roofing manufacturer under the Uniform Commercial Code. The code states that the manufacturer's product must be suitable for its intended use. The legal task is to define the roof system as a product. In Illinois, the owner must file an action within four years of initial installation.

Construction-Claim Statutes

The owner can recover damages for a faulty roof because of the general or prime contractor's installation under the construction-claim statutes. Again, specific manufacturer warranties may take precedent. Under construction-claim statutes, the general contractor would be sued; he would, in turn, sue the manufacturer. The owner often realizes little satisfaction under this action because general contractors have insufficient recoverable assets to satisfy a large dispute. In Illinois, the owner must file an action within ten years following installation and four years after discovery; consequently, any suit may be filed ten years after the roof installation.

The Roof-Contractor Guarantee

The installing roof contractor typically offers a guarantee for workmanship and materials for the first two years of a new roof's life; after that, the manufacturer assumes the same responsibility for a long-term period. The contractor's guarantee for repair work on an existing roof typically lasts for one year and applies only to the immediate area of the repair. There are no guarantees for repairs to roofs that are in poor condition and need replacement.

In more unusual situations, contractors may offer proprietary, long-term labor and material guarantees that are not endorsed by specific manufacturers and are intended as substitutes. Owners should beware of these arrange-

ments because some contractors offering them are judged unqualified by the manufacturers to provide acceptable installations. To stay competitive for certain projects, these contractors buy the materials themselves through the supply houses, offer their own guarantee, circumvent the manufacturer's quality-control scrutiny, and convince the unsuspecting owner that their guarantee is as good as the manufacturer's. As with a general contractor, the owner has little chance of recovering a large dispute directly from the limited assets of the roofing contractor.

The Manufacturer Warranty

Over the last 15 years, the manufacturer warranty has become the standard document insuring roof-system performance. Nevertheless, it is a controversial issue within the industry. Many manufacturers would prefer not to offer a long-term commitment on their systems. However, the realities of today's competitive roofing marketplace, one that has exploded from a handful of major players in the last decade to almost 100 at this time, dictate that they do. Today's marketplace also forces many manufacturers to use their warranties as their main marketing tool.

Manufacturer warranties cover a variety of roofing products and situations:

- System warranty
- Labor and material warranty
- Warranty extensions
- Material warranty

The discussion of this list starts with the system warranty, the most stringent of agreements, and moves to the material warranty, which has the least liability for the manufacturer.

System Warranty

In a system warranty, the manufacturer accepts performance liability for labor and materials and for installations other than the roof membrane. For example, it might include the insulation and, perhaps, some sheet metal if that is supplied under a licensing agreement with the manufacturer. Membrane roofs—built-up, modified-asphalt, and single-ply—most often offer system warranties, as do pre-engineered metal roofs. Sprayed urethane roofs include the field-applied foam and the liquid coating as their system.

The system warranty is considered in the owner's best interest, since it generally includes the insulation that might need replacement in a permanent repair. Current periods vary from ten years for most single-ply systems to twenty-five years for some built-up roofs. For the first two years, the installing contractor is responsible for labor costs.

Charges for the system warranty are billed separately from the materials. The current cost for single-ply systems is twice that of built-up or modified roofs.

The potential recovery amount varies with the agreement. Some warranties declare a no-dollar limit, while others are prorated over the service life.

System guarantees usually cover the manufacturer's premier products, details and procedures. Also, many manufacturers select system contractors whose workmanship and experience can produce the superior quality necessary for the warranty. Nevertheless, frantic demands to sell the product often corrupt the screening process, since contractors remain the manufacturers' chief source of commercial sales.

Labor and Material Warranty

Labor and material warranties generally cover only the waterproofing membrane and not the insulation or contiguous metal flashing. There is a separate, lower service charge, and the warranty periods, up to 15 years, are less. Most of these prorate the recoverable amounts.

Warranty Extensions

Many agreements are structured for a base service period of five to ten years, followed by an optional extension. This is subject to the manufacturer's reinspection of the roof (he may reject the option if the roof is in poor condition) and the owner's payment of an additional fee.

Material Warranty

A material warranty covers only the manufacturer's material product and not the installation. Consequently, in failure recoveries, the manufacturer is required only to provide new materials for the owner to install at his own expense, including removal of the failed materials.

Shingle products are typically warranted for material only, because any unqualified contractor or person can purchase any shingle product for self-installation. The manufacturer has no opportunity to maintain quality control. Most membrane and metal manufacturers have lesser material warranties, along with more inclusive agreements.

"System guarantees usually cover the manufacturer's premier products, details and procedures."

Owner Scrutiny

The owner and the architect/consultant must carefully scrutinize the submitted guarantee document for compliance with the specifications. Most manufacturers offer several agreements whose visual presentations may be similar but that are worded very differently. A weaker warranty, which is less expensive to the contractor, is sometimes substituted and overlooked by the parties anxious to finish the project; the error may not be discovered until years later, when enforcement is impossible.

Important Warranty Features

Every warranty is unique and is carefully worded to protect the manufacturer's specific interest. However, there are many features and qualifications common to

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most documents. The following samples demonstrate some routine issues.

- The owner must formally notify the manufacturer of a leak; caution is needed, however, because some documents have a condensed response period, even as short as 48 hours after the leak occurs. Most manufacturers allow the owner to make emergency repairs to stop serious damage to the building.
- Warranties do not cover consequential damages to the building and its contents and/or the loss of business expenses.
- There are many conditions in which the warranty does not apply. These will be discussed later in some detail.
- The owner cannot make alterations to the roof without the consent of the manufacturer. This prevents the owner from using unapproved repair methods. The owner cannot abuse the roof; any damage done by individuals is not covered.
- The owner must maintain the roof by keeping it free of debris and by cleaning gutters and roof drains. Warranties do cover normal wear and aging.
- The owner must allow reasonable access to the roof.
- The warranty document supersedes any other warranties and precludes any action under the Uniform Commercial Code or construction claims.
- Many building leaks are not roof-related but are from walls, louvers and related constructions that were not supplied by the roof manufacturer. These are the responsibility of the owner.
- Any deviations from the printed document must be in writing from an authorized person. All too often a high pressure salesperson makes unauthorized warranty-deviation claims that cannot be written into the final warranty agreement.

Benefits of Warranties

Warranties provide tangible benefits. First, they tie the manufacturers, who have the most recoverable assets, to the roof for a long period. As mentioned previously, the contractor would most likely not have the assets to cover a large dispute. The architect might have an insurance policy to cover culpability.

System warranties help the owner, through the manufacturer, prequalify contractors and bar unqualified ones. For private sector owners, this is not a key issue, but public owners are forever at the mercy of marginal bidders.

The owner will not pay for many leak repairs during the term of the warranty; however, this benefit varies widely among manufacturers. In a marginal or poorly performing roof, this can save a significant amount of money. A good roof system that has a good history, is properly designed, and is correctly installed will not benefit as much. Nevertheless, while the warranty cost on a major roof will be thousands of dollars, its relative expense in the scope of a large project is small.

Reputable manufacturers may replace a failed roof at their expense. This is more probable if the manufacturer has effective product insurance. Thus, with a long-term warranty, most public owners feel a sense of security. They believe that they have an insurance policy for the expected life of an expensive, new asset.

"Most warranties exclude wind conditions exceeding gale force, defined as 40 miles per hour."

Drawbacks and Pitfalls

There is no such thing as a free lunch. Consequently, along with the benefits, there are many disadvantages associated with long-term warranties.

The first issue concerns practical enforceability. The reader of the warranty document soon realizes that half the text deals with conditions and situations which are not covered or that automatically cancel it. While many of these conditions are justified, many more allow the manufacturer a convenient exit from warranty obligations. The following is a sampling of some of the more popular terms, limitations and cancelling conditions that generate enforcement loopholes:

- *Wind damage*—Most warranties exclude wind conditions exceeding gale force, defined as 40 miles per hour. The gusts of many routine thunderstorms exceed this limit.
- *Failure of materials supplied by others*—Generally, this means the insulation under the membrane. At present, manufacturers can approve specific insulations for their systems, yet, they may accept no responsibility when those same insulations cause their systems to fail.
- *Lack of proper drainage*—Most roofs pond water. The current industry standard states that the water which dries after 48 hours is not a roofing threat. The owner will probably have some pond on the roof that unknowingly is not covered by the warranty. There are some systems that allow ponding.
- *Roof deck or building movement*—All buildings move, and all roof decks deflect: some more than others. If manufacturers take issue with certain types of decks, then they must state their concern before the warranty is issued. This is easily abused.
- *Judgement authority*—Many warranties state that the manufacturer is the sole judge on the applicability of the terms and conditions. More than any other provision, this underlines the one-way nature of the warranty document that limits the owner's power in determining the roof's fate.

In addition to these loopholes, there are other enforcement difficulties. One involves the size of the account: the customer who purchases large amounts of materials will receive better service than the owner of a small, single roof. In this instance, the architect or consultant can offer the owner more clout with the manufacturer.

Many reputable manufacturers employ their qualified installers as service contractors. However,

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manufacturers with extremely large numbers of problems and warranty payouts have found it more cost effective to use their own in-house repair forces. This might be a flag to the owner of a distressed roof that there are many others out there with the same problems.

Will the manufacturer still be in business when the warranty needs to be exercised? A review of the National Roofing Contractors Association (NRCA) *Roofing Materials Guide* reveals that, of the 77 reporting companies listed in 1986, only 53 were still in business in 1992; the 24 others had reorganized, gone out of business, or withdrawn from listing as manufacturers. This attrition rate suggests that, near the end of a typical ten-year warranty, the owner has only a 50 percent chance that the manufacturer will still be in business (Figure 1). These alarming statistics underscore the instability of the roofing industry. Recently, one major single-ply manufacturer who has been very active over the last ten years has just been taken over by its third owner.

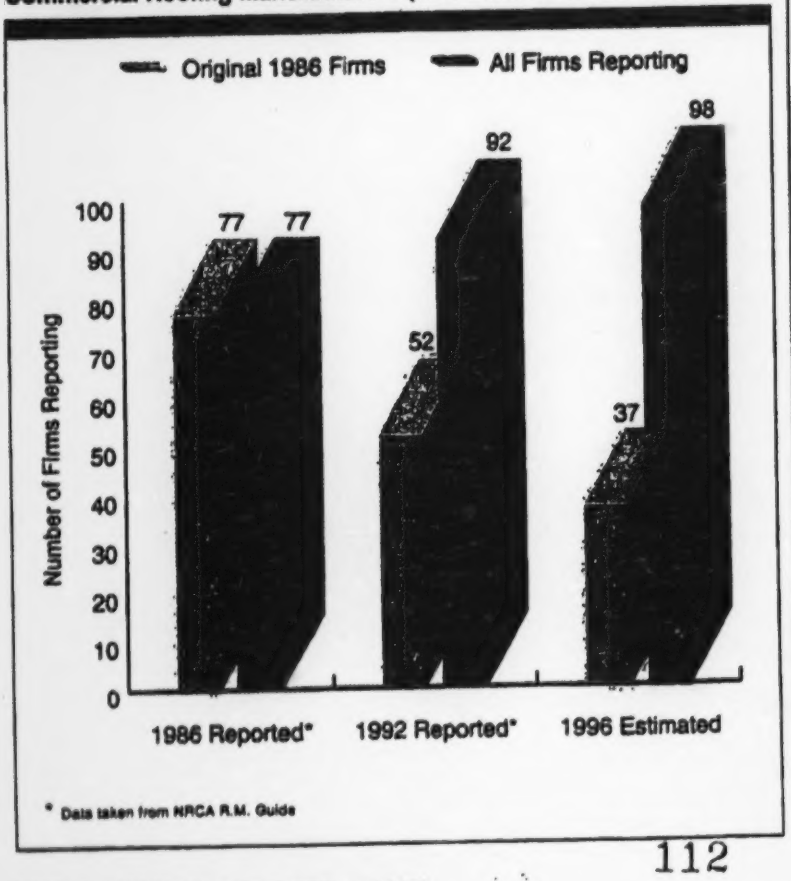
When a roofing company is sold, the acquiring company generally does not assume the liability for the past roofs. The old company still holding the warranty changes its service attitude. Now, the company does not have to respond to warranty-service calls to maintain its good name, which sells more product; it does so to hold down costs and minimize losses. The manufacturer offers the minimum repairs necessary to stop a frustrated owner from bringing suit. Nevertheless, at the end of the warranty period, the departing manufacturer often leaves the owner with a roof in need of imminent replacement.

Over the last fifteen years, warranties have become more effective marketing tools than insurance policies. What is the best method for a manufacturer to sell a new, untested and possibly very risky product? Guarantee it for ten or more years, depending on what others are doing; improve or correct the product when it starts to fail; and hope the new sales can overcome the losses.

In a major dispute settlement, the judge will invariably prorate the amount over the service life, even if there is a no-dollar-limit provision in the warranty. Therefore, it is important for the owner to discover a potential failure as soon as a pattern is apparent. Again, warranties reject consequential damages.

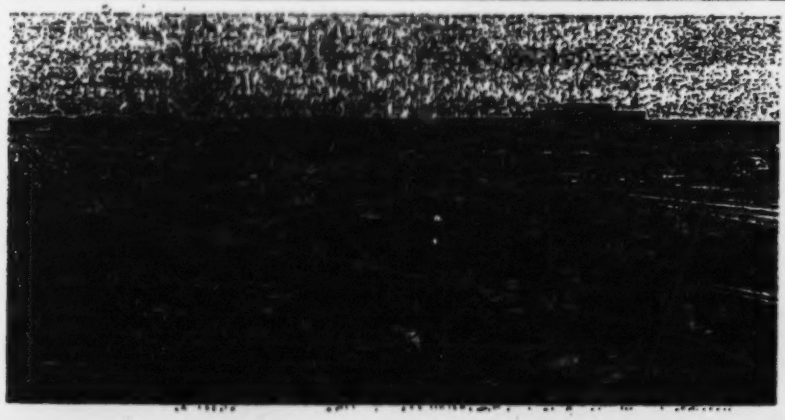
There is another subtle drawback. Good warranty service from a reliable manufacturer can lull an owner into preventive maintenance (PM) complacency; the owner thinks that warranty calls supplant in-house PM inspections and cleanings. In a recent roof inspection, the owner complained about repeated leaks which had occurred over the previous three years. When the roof was examined, the mechanically attached, single-ply membrane was billowing like a balloon and failing (see photo, pg. 12). Some of the earlier manufacturer service calls involved attempts to resecure the roof, but they were only partially effective. The owner had, obviously, neither routinely inspected the roof nor queried the service contractor as to the nature of the problem. He had, in effect, relied on the warranty service to manage the roof.

FIGURE 1
Commercial Roofing Manufacturers (Non-metal Membrane Mfrs.)



Other Issues

There exist certain manufacturer/architect agreements of which the roof owner should be cognizant. These involve agreements by manufacturers to defend and hold the architect harmless if he specifies the manufacturer's roof system. The American Institute of Architects has declared this practice unethical when an architect fails "to disclose to the client or employer the indemnification offer from the roofing material supplier, which gave a clear benefit to the architect." This is another manufacturer sales tactic that clouds the architect's unbiased judgement in choosing the correct roof for the *owner*.



Guidelines and Directions

Owners should follow these guidelines when buying a roof.

- Always buy an industry-proven, safe system. Never buy the latest thing. Industry-proven means a track record of fifteen years or more, in place, in volume, as testified by the NRCA (*Operation Pinpoint* tracks the performance of roofing systems) or by an independent consultant. Very inexpensive roofing systems are generally risky.
- Never consider the warranty a major criterion in the selection. Eliminate a roofing system whose main feature is the warranty rather than demonstrated performance.
- During construction, buy "roof insurance" through more aggressive field observation by the architect or consultant. Manufacturer's inspectors are not independent.
- Owners should not design their own roofs unless they have comprehensive experience and know the current roofing market.
- Realize what the owner is buying in a warranty. Keep it accessible. Seek opinions from an independent source: a peer, an independent consultant.

The owner who follows these guidelines will get the best roofing value with be no surprising results.

What are Various Opinions?

In facing a difficult decision, the owner will probably seek the advice of various interested persons. Therefore, the responses from the owner's attorney, the architect, the contractor and the roof consultant on the value of the long-term warranty should be considered.

The person with the last word in these matters is often the owner's attorney. Interviews with attorneys reveal that they generally favor long-term warranties. With the warranty, they see a more direct access to the manufacturers' deep pockets than through multi-stage litigation against a general contractor with limited assets. Enforceability is a lesser issue than the availability of funds to recover.

Architects favor the warranties as long-term insurance. However, too often they buy into the same warranty-sales schemes that sell the uneducated owner. Furthermore, they are removed from the owner's frustrating warranty-management situation. If architects were required to respond to warranty claims for no compensation, their favorable opinion of warranties and risky roofing systems would rapidly change.

Finally, roof consultants generally do not favor long-term warranties. More often they are involved in lengthy legal proceedings as expert witnesses, and they, more than others, see the real value of these agreements and the difficulty of enforcement.

Various types of remedies are available to the owner in a roofing dispute. The long-term manufacturer warranty has been given the greatest scrutiny. Although there are drawbacks for every benefit, owners must decide the relative value of each for their particular situations.

Mr. Royko will now have a few more gripes for next year's column.

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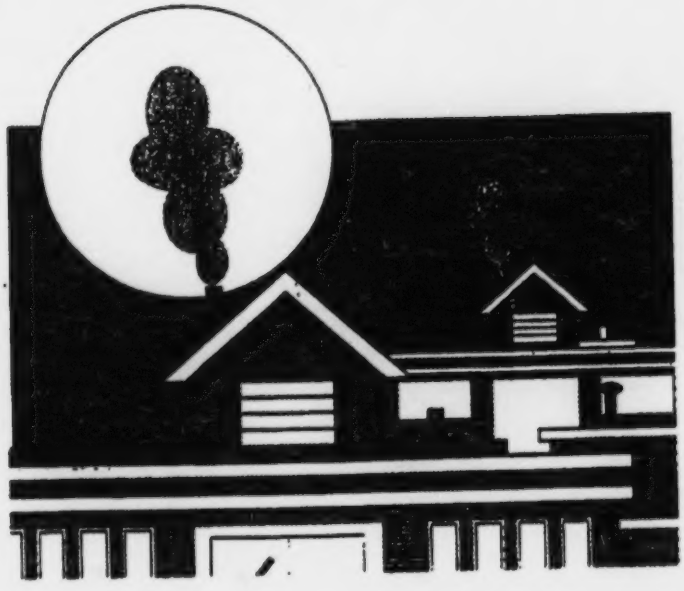
Environmental Issues



Life in a Regulated Environment
Do You Comply with Environmental Laws?

By Kevin J. McKeague

If you feel that the passage of time is synonymous with the growth of government regulations, you're probably right. With every passing year, government regulations and related reporting requirements seem to become more and more voluminous. However, as you ponder the three-inch stack of paper sitting on what you may vaguely remember as your desk, it is important to keep in mind that the purpose of all this reporting is the health and safety of students and employees. With that in mind, here is a brief overview of the latest changes in government regulations and reporting, and also a glimpse into what is on the horizon.

Beginning with some of the regulations that we do know and progressing along to some of the new regulations, our discussion will begin with building code issues, the implications of the Americans with Disabilities Act (ADA), the Asbestos Hazard Emergency Response Act (AHERA) regulations, the new lead guidelines as related to paint and other sources of exposure, requirements regarding underground storage tanks, the emerging area of indoor air quality, and finally, the effect current U.S. Occupational Safety and Health Administration (OSHA) guidelines may have on your facilities.

Americans With Disabilities Act

The ADA requirements have had very far-reaching consequences with regard to building accessibility for the disabled. ADA states that most public buildings must be accessible to the disabled and building owners must do whatever is necessary to make sure no one with a disability is discriminated against. This includes the removal of architectural barriers where removal is readily achievable. This not only refers to allocating parking spaces for the physically handicapped, but also includes renovating doorways, toilet rooms, ramps, etc., to accommodate those in wheelchairs, as well as other physically disabled people. ADA is also potentially applicable to people with respiratory problems where "clean air" accommodations may be necessary. It is best to seek the advice of an architect who is versed in the provisions of the new act to survey your school (if you have not already done so) and can recommend a strategy for compliance.

Asbestos

Facility administrators who oversee buildings that were built before the 1980s are aware of the requirements dealing with asbestos. AHERA, passed in 1987, made the inspection and operations and maintenance procedures for working around asbestos in public and private K-12 schools quite cumbersome.

A copy of the school's AHERA Management Plan, including operations and maintenance procedures for working in and around asbestos-containing building materials in the school must be kept on file at the school. The requirements for the three-year reinspections are still in effect. By most calendars, initial management plans were filed in 1988; the follow-up reports for the three-year reinspections were typically filed in 1992; hence most jurisdictions must conduct another three-year reinspection and refile an updated management plan in 1995.

A somewhat less known provision of AHERA is the requirement to perform six-month surveillance of all of the identified asbestos-containing building material (ACBM) in school buildings. Because filing the periodic inspection with state authorities is not a requirement, it is a provision that is often overlooked.

Also often overlooked is the AHERA provision of public disclosure of AHERA compliance. This might take the form of a letter to parents or public notice in a local newspaper.

Lead

Department of Housing and Urban Development (HUD)

Since the mid-1970s, HUD has spearheaded the federal effort to eliminate the hazards of lead based paint (LBP) in housing. Currently, the only federal standard which defines what is considered LBP is HUD's guidelines for LBP in public and Native American housing. HUD guidelines define LBP as paint containing greater than .5 percent of lead by weight (or 5,000 ppm) and defines an LBP hazard as any exterior or interior surface containing LBP that is accessible to exposure by children. HUD mandates inspections for LBP hazards in all pre-1978 public housing family dwelling units.

Environmental Protection Agency (EPA)

EPA's Office of Pollution Prevention and Toxics (OPPT), under mandate by the Toxic Substances Control Act (TSCA), has recently proposed hazard education requirements to ensure that owners and occupants of target housing understand the potential hazards of LBP exposure before renovations are begun. Specifically, before renovating target housing for compensation, renovators would be required to provide an EPA lead hazard information pamphlet to owners and occupants. This pamphlet would, in addition to providing general information on LBP hazards, advise owners and occupants to take precautions to avoid exposures to lead-based dusts and LBP debris that are common during renovations.

OPPT recently made available draft renovation and remodeling guidelines entitled, "Reducing Lead Hazards When Remodeling Your Home." OPPT is also developing health-based standards for lead in paint, dust and soil.

The provisions of the Safe Drinking Water Act enacted in 1974 require testing of drinking water for threshold limits of lead, among other contaminants. The Lead Contamination Control Act, enacted on October 31, 1988, amended the Safe Drinking Water Act.

Department of Labor (DOL)

OSHA recently published regulations governing workers' exposure to lead in the construction industry (29CFR-1926.62). OSHA does not define what is considered LBP. The regulations govern all construction work where an employee has the potential of being exposed to airborne lead levels greater than the permissible exposure limit (PEL) of 50 micrograms per cubic meter of air.

"All 50 states have programs addressing lead-poisoning prevention. Many state laws require children 6 months to 6 years of age to be screened for lead poisoning."

Schools should determine if materials or surfaces that are to be renovated contain lead. If so, the contractor should be informed so that required worker protection can be provided and protective measures can be taken to prevent lead contamination of the school during renovation.

State Regulations

Many states have established environmental protection regulations based on EPA requirements for LBP hazards. All 50 states have programs addressing lead-poisoning prevention. Many state laws require children 6 months to 6 years of age to be screened for lead poisoning. An elevated blood lead level in a child triggers a case follow-up by delegate agencies. In some cases follow-up inspections of schools, playgrounds, child care facilities or residential buildings may be performed to determine the sources of lead poisoning.

State findings from child lead screening programs and current EPA research efforts may provide information on sources of lead poisoning that could potentially result in increased lead abatement projects in schools. Although no specific guidelines currently mandate inspections and control of LBP in schools, the momentum of federal and state environmental regulations could precipitate LBP requirements similar to regulations regarding asbestos-containing materials in schools.

Underground Storage Tanks (USTs)

Federal regulations for underground storage tanks (USTs) require leak detection, corrosion protection and spill/overfill prevention. The requirements apply to tanks, pressurized piping and suction piping systems. States have adopted the federal regulations in whole or with some modifications. Since each state varies, this article does not touch on all specific requirements.

The requirement is to have all new tank and piping systems, those installed after December, 1988, meet all of the requirements at the time of installation. This should be done by the tank installer, but does require routine activities to monitor the systems. Existing tanks, those in place before December 1988, have various requirements by age of the tank. The ultimate goal is full upgrade of existing tank systems by 1998.

Tank systems require three controls: leak detection, corrosion prevention, and spill/overfill protection. Leak detection is the most intensive requirement and can be accomplished through either monthly monitoring or monthly inventory control with a tank tightness test every five years. Monthly monitoring options include automatic tank gauging, vapor monitoring, interstitial monitoring or groundwater monitoring.

Existing tanks can use the above methods with a slight modification. The monthly inventory control requires an annual tank tightness test unless corrosion protection and spill/

overfill prevention have been installed. When corrosion protection and spill/overfill prevention have been installed, the test can go to a five-year basis.

Indoor Environmental Quality

OSHA has recently proposed a new standard addressing indoor air quality and the indoor work environment. If adopted, the proposed standard would apply to employees in all indoor, non-industrial work environments, private schools included. Although state school employees are not covered directly by federal OSHA regulation, state regulatory agencies have historically adopted OSHA standards and will likely do so in this case.

The proposed standard would require employers to develop and implement a written indoor air quality compliance program. HVAC systems would have to be operated and maintained to assure performance to original design specifications. Also, a written record would have to be made of employee complaints with employees allowed access to the files for copying. If smoking is allowed within a building, there must be designated smoking areas exhausted directly to the outside.

FIGURE 1
Environmental Regulations Overview

Americans With Disabilities Act

Survey of school by architect versed in the Act

Asbestos (AHERA)

Schedule and budget for next 3-year reinspection
Periodic surveillance program
Operation and maintenance program
Filing of public notice of compliance with AHERA

Lead

Lead test of paint before renovation
Test drinking water

Underground Storage Tanks

Leak protection
Corrosion protection
Spill/overfill protection

Indoor Environmental Quality

Written compliance program (potential future requirement)

Hazard Communication

File of Material Data Sheets on hand
Install hazard communication program with employees
Inventory flammable materials and designate special storage areas outfitted according to local code or National Fire Protection Association guidelines

Air Pollution

Begin looking at cost of alternatives to halon and CFC refrigerants
Determine if employee commute trip reduction requirements apply in your situation

Hazard Communication or "Right to Know"

This OSHA standard was promulgated several years ago, but it still causes compliance problems. Most employers know about the requirement for an employee-accessible file of material safety data sheets (MSDSs). However, according to OSHA citation records, many employers do not realize that there is much more to complying with the standard. In addition to having an MSDS for each potentially hazardous chemical product used, there must also be a written compliance program, chemical product inventory and hazard-specific employee training.

In addition, the employer's hazard communication program has to anticipate chemical hazards involved with "unusual jobs." Tank entry and cleaning would be an example of an unusual job. Also, there must be provision to share information on multi-employer job sites. For example, a janitorial service must share information with the school staff if the staff may be exposed to the janitorial products used. Conversely, the janitorial service also has the right to access the school's MSDS information where janitor exposure to the school's products is foreseeable.

Storage of Flammable Materials

The storage of hazardous or flammable materials is regulated by local building codes. Generally, most building codes refer to the National Fire Protection Association (NFPA) guidelines. The NFPA guidelines specify specific limits of flammable materials that may be stored and under what type of provisions. For example, large quantities of ma-

terials with low flash points may need to be stored in an outhouse or in a room outfitted with explosion panels. Likewise the need for emergency eye wash and decontamination equipment may be necessary.

Air Pollution

As a result of the Clean Air Act (CAA) passed in 1990, the use of CFCs in air conditioning and halon (commonly found in fire protection systems) is being phased out. Suitable alternatives are being offered by chemical manufacturers. Consequently, existing air conditioning and halon fire protection systems may require retrofitting to accept substitute gases.

In addition, under Title I, the Employee Commute Options (ECO) provisions of the Act, facilities with 100 or more employees may be required to initiate carpooling programs or other commuting alternatives to reduce auto emissions. This is a program intended to help non-attainment areas meet national ambient air quality standards for pollutants linked to both mobile and non-mobile sources.

Conclusion

If you are not in compliance with the regulations outlined in this article, now is the time to catch up. Not only will you avoid some stiff penalties, you will be prepared to deal with new regulations that are sure to be sent your way care of the federal government. ❑

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The ABCs of Non-Toxic Pest Control

By Susan Cooper

The use and misuse of pesticides in our food, homes, workplaces, and schools affects every one of us. Pesticides are chemicals designed to be toxic or otherwise harmful to pests that can be a nuisance or a health hazard. Unfortunately, most pesticides are also harmful to other organisms, including people. Children are especially susceptible to the dangers of chemical pesticides. While chemical-intensive pest control methods have proven reasonably effective, a growing awareness of the health and environmental risks associated with pesticides has sharpened public interest in safer alternatives.

Statistics on pesticide poisoning in schools are not available, but the National Coalition Against the Misuse of Pesticides (NCAMP), a public interest group located in Washington, DC, receives numerous inquiries from school administrators, teachers, and parents who are concerned about the use of pesticides in their schools. Many of these requests for information are from teachers or parents who believe that their children's health has been affected by pesticides used in or around their schools.

The contamination of indoor air by pesticides is a topic of increasing concern among public health officials. The EPA recently conducted a Non-Occupational Pesticide Exposure Study which found indoor air concentrations of many common pesticides to be more than 10 times greater than outdoor concentrations.

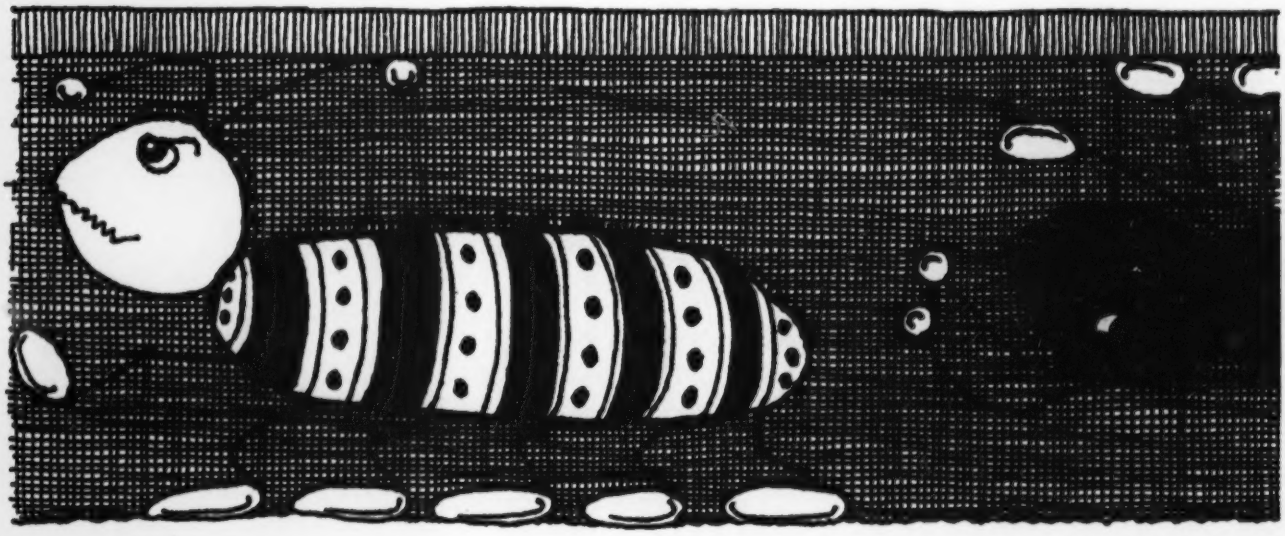
While most of us would like to believe that the air we breathe is safe, indoor contamination by pesticides can reach levels posing significant health risks. In May 1989, for example, the National Institute of Occupational Safety and Health closed a West Virginia junior high school after a carcinogenic termiticide was found in concentrations of 11 times the evacuation threshold.

Chemical controls are costly, they involve a host of health and liability risks, and their efficacy is being reduced as pests develop resistance to the most widely used pesticides. Because of these and other issues, experts around the country are developing new concepts of pest management which involve both non-chemical and chemical controls. This set of techniques is often dubbed "integrated pest management" (IPM).

Pest Problems in Schools

Schools typically contain many areas that have the potential to develop pest problems. These include food preparation facilities, dining and snack areas, waste storage facilities, and extensive areas of turf and tree plantings.

There are still many wooden school buildings that attract termites and other structural pests. Pest problems can develop that are not only a nuisance but can also be health threatening. Examples are cockroaches and rodents that can carry human disease, stinging insects, allergenic weeds such as poison ivy and ragweed, and moles whose activities can make athletic fields unsafe.



Children Are at Greatest Risk

According to Dr. Beverly Paigen, research biochemist at the Children's Hospital Medical Center in Oakland, California, children are more sensitive to toxic chemicals than are adults.[1] Because children are growing and are more active than adults, they require more food and oxygen, and so receive a higher dose of those toxins per pound of body weight.

Also, because children are actively growing, their cells are dividing at a rapid rate, making them more susceptible to toxins, such as carcinogens, which are more damaging to rapidly dividing cells. A study performed by the National Cancer Institute found a 6.5-fold increased risk of childhood leukemia for children whose parents use garden and household pesticides.[2] In addition, children's organs may be more easily affected by toxins than are adults'.

The differences in behavior between children and adults can also result in children being exposed to greater levels of pesticides. Children are much more likely to crawl around places treated by pesticides or to roll on turf or climb through shrubbery that has been sprayed.

An especially serious concern for children is neurotoxicity, or effects on the brain and nervous system. The U.S. Environmental Protection Agency (EPA), which governs the registration of all pesticides, is currently considering regulations that would require the testing of all pesticides for neurotoxic and immune system effects. Such tests are presently not required and neurotoxic effects remain unknown for most commonly-used pesticides.

Nonetheless, a number of recent studies have found that even low-level exposure to neurotoxins during nervous system development can cause long-term nervous system impairment.[3] Neurotoxic effects can range from headaches, dizziness, and memory loss, to learning disabilities, hyperactivity, and permanent brain damage. Damage to the immune system can result in increased problems with allergies, asthma, and hypersensitivity to chemicals and a reduced ability to combat infections and cancer.

Responding to Pest Problems

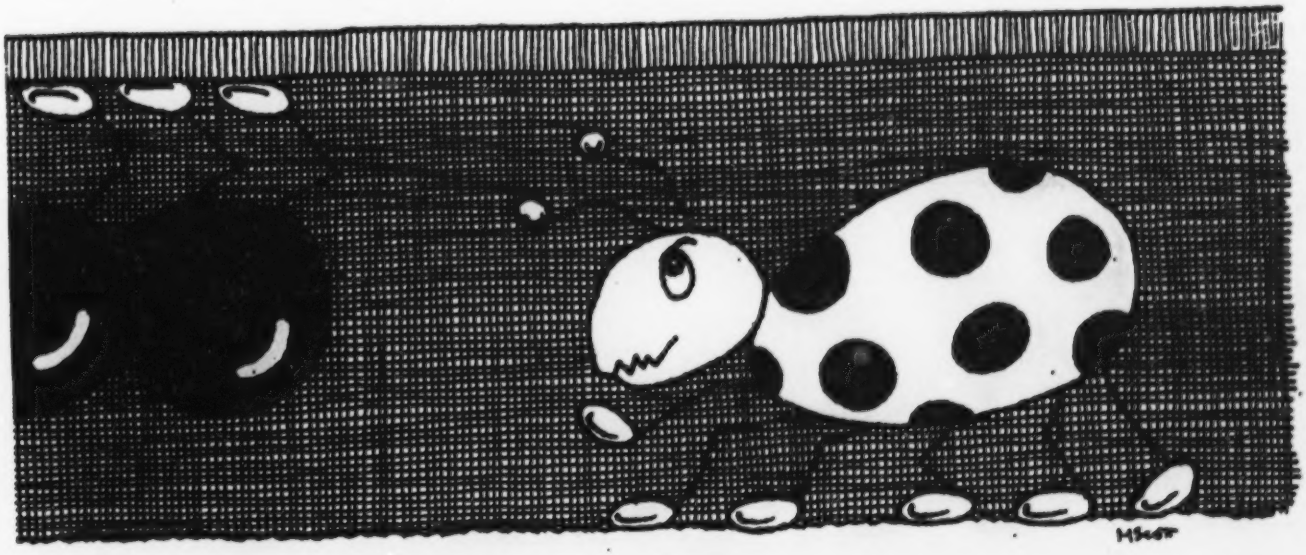
Most schools currently manage pests solely by applying chemical pesticides. This approach tends to rely on a two-part program that, unfortunately, often encourages the overuse of pesticides. First, a facility is treated with chemical pesticides on a regular basis regardless of whether or not the pest is even present. Obviously, this can result in unnecessary pesticide use. Second, pesticides are applied when the pest population has reached an unacceptable level. The problem with this type of response is that there is a tendency to overreact, also leading to pesticide overuse.

Research by the consumer safety group Public Citizen found that many school system pesticide applicators have not received any formal pest control training. Without appropriate training in the handling of pesticides, many of which are highly toxic, applicators can put themselves and all of the inhabitants of a school at risk.

Integrated Pest Management

It is clearly in everyone's best interest to foster a safe school environment, free from pests. Fortunately, a solution exists which not only provides excellent long-term control of pests, but poses the least risk to students, teachers, administrators, and maintenance staff. The solution is integrated pest management (IPM).

IPM is an effective and environmentally sound approach to pest management. IPM reduces risks from pests and pesticides by minimizing human exposure and by reducing the toxicity of materials used to control pests. IPM relies on:



- prevention of infestation;
- monitoring of pest populations, with action being taken only when populations exceed acceptable levels; and
- a range of non-chemical control methods.

Controlling pests through an IPM program requires a basic understanding of pest behaviors and needs in order to choose effective, safe, and low-cost methods of control. Pests, like other forms of life, require food, water, and harborage. Denying pests access to these fundamentals of life is the foundation of long-term pest management programs.

For example, cockroaches thrive in small enclosed spaces, areas which are moist or wet, and areas with abundant food. Therefore, preventive and remedial measures that are effective include improving sanitation and waste disposal techniques, fixing leaky pipes and faucets, rinsing and drying mops, reducing clutter, and sealing cracks and crevices. In general, key practices include:

- *monitoring* — tracking the location and level of pest populations;
- *sanitation* — removing food scraps from food preparation areas;
- *waste management* — keeping waste containers tightly closed;
- *structural maintenance* — fixing leaky or sweaty pipes;
- *physical barriers* — screening windows and vents;
- *habitat modification* — removing clutter;
- *physical removal* — steam treatments;
- *traps* — insect and rodent traps;
- *biological controls* — ladybugs or lacewings; and
- *pesticides* — as a last resort, starting with least toxic materials such as boric acid, growth regulators, and baits.

An efficient IPM program will also include staff training, certification of applicators, and occupant education. Thus, the IPM decision framework involves:

- designating roles for occupants, pest managers, and key decision-makers such as the facilities manager;
- determining pest management objectives for each area of school buildings;
- incorporating preventive measures into building maintenance and housekeeping;
- incorporating preventive measures into the design of new buildings and grounds;
- setting action thresholds — the point at which pest populations demand remedial action;
- evaluating options for problem solving, including physical, behavioral, and chemical actions;
- minimizing the use of pesticides, but when applied, using techniques that maximize exposure to the target pest, such as crack and crevice treatment, and minimize exposure to occupants;
- monitoring pests, evaluating results, and keeping written records; and
- establishing policies to notify all building occupants and parents of upcoming pesticide applications.

IPM methods are founded on good, common sense. The key to a successful program is in the education and training of all of those involved — administrators, pest control managers, teachers, and students.

Experience with IPM indicates that a good program in schools can effectively control pests, at no greater cost, with fewer complaints of pest infestation, and can provide a healthier environment for all school occupants.

Costs

Pest management costs are usually a very small portion of a school system's budget, and indeed rarely even appear as a line item. Nevertheless, the comparative costs of IPM and conventional pest control methods may encourage a school to switch to IPM.

Evidence from ongoing IPM programs in schools and parks across the country indicates that IPM methods cost no more than conventional methods and a well-run program may even provide significant savings. IPM eliminates costly and often ineffective preventive pesticide applications, replacing them with far less expensive monitoring techniques. IPM also substitutes permanent structural changes for more temporary chemical treatments which would have to be repeated again and again.

As the program begins there may be some costs associated with conversion, such as purchasing new materials like screening, but these costs should be recovered within the first two years of the program and benefits will continue to accrue in the ensuing years. First-year program costs can also be minimized if the school is able to monitor for pests with in-house personnel rather than contracting out all services.

Exact figures for conversion to IPM can be difficult to calculate, as an effective IPM program can distribute costs across many budgetary categories not typically associated with pest control. For example, structural repairs may be allocated to the maintenance budget, while improving sanitation techniques might appear as a housekeeping item. Cost savings that may be difficult to estimate include IPM's reduced need for hazardous waste disposal.

A Success Story: Montgomery County, Maryland, Schools

According to Bill Forbes, pest management supervisor for Montgomery County, Maryland's school system, "The county has reduced its pest control costs by implementing IPM, and at the same time has improved teacher, parent, student and administrative satisfaction with the program. Most importantly, we have fewer pest problems than ever before!" While noting that subtle costs, like changes in sanitation practices, can be difficult to calculate, Forbes says, "Under the conventional system of pest control, the schools spent an average of $513 per school per year. This cost covered two salaries, two vehicles, and materials for two employees. Their scope of operation included only crawling insects and rodents, at 150 locations. Other work, including termite control, was contracted out at additional cost."

He notes that, "Current costs for the IPM program cover 200 service locations, three vehicles, three full time employees, and virtually every structural pest from pigeons to roaches to termites, for a total cost of $575 per school per year. Prior to the implementation of the IPM program,

11 locations were contracted out to a local firm. The firm charged $2400 per school per year, while the IPM operating costs for those schools for FY 1991 should run about $500 per school."

Forbes explains that as personnel gain experience and structural changes are implemented, costs continue to go down.

In the past two years, Forbes' growing reputation as an IPM innovator has caused other school systems to seek his advice on conversion and pilot programs, including Anne Arundel County, Maryland, Ann Arbor, Michigan, and Dade County, Florida.

Ann Arbor had excellent success with the first year of their program. A contractor was hired to monitor the 35 schools regularly, with instructions to take remedial action only when it was indicated and after appropriate authorization. During the entire year, only one application for cockroach control proved necessary, and the population was adequately controlled with a crack and crevice treatment of the low toxicity product boric acid. Costs were the same as under the conventional regime. However, during FY 1991 the school staff will perform the monitoring, calling in professional applicators when population levels exceed thresholds, and this will markedly reduce program costs.

Administrative Policies and Contracts

For many schools, the first step in the transition may be an official IPM policy statement. Such a policy should establish guidelines for the selection of pest management strategies. In addition, where contractors are used for pest control, procurement contracts should be carefully examined to make sure that bidders will be aware of the school's IPM policy. Be sure that the contracts are "results oriented" rather than "application oriented."

Some of the concerns that might be addressed in a contract are insurance and state licensing, establishment of pest threshold levels, type of monitoring to occur, products to be permitted, alternative practices to be used prior to pesticidal treatment, posting and notification prior to application, and a statement of expected results.

Help Is on the Way

While these concerns may seem overwhelming, do not despair. NCAMP, along with many other knowledgeable experts including Bill Forbes, has been helping EPA prepare an IPM guidance booklet for school administrators, to be published early this fall. The booklet will include sample policies and contracts, along with a thorough introduction to the principles and practices of IPM.[4]

In light of improving pest control technology and increased awareness of the hazards of pesticides, it is time to rethink routines that have become commonplace, to take an inventory of the toxic chemicals you use, to evaluate their effectiveness, and to reduce human exposure to pesticides.

IPM works. It will protect your students and your staff, and increase the confidence of parents that their children are not at risk. IPM will also protect the structure and the school grounds, and save you money in the long run [Ed. Note: Ordering information for the EPA guide can be found in *ASBO Accents* when the guide is published this fall.]❑

Footnotes

1. See also Calabrese, E.J. (1986). *Age and Susceptibility to Toxic Substances*. John Wiley & Sons.
2. Lowengart, R.A. et al. (1987). Childhood leukemia and parents' occupational and home exposures. *Journal of the National Cancer Institute*, 79(1), 29-46.
3. Wiggins, R.C. (1986). Myelination: A crticial stage in development. *Neurotoxology*, 7(2), 103-120. Reiter, L.W. (1982). Age-related effects of chemicals on the central nervous system. In Hunt, V.R. et al. (eds.), *Benbury Report 11, Environmental Factors in Human Growth and Development*, Cold Spring Harbor Laboratory.
4. For more information on EPA's school IPM guidance document, contact William Currie, U.S. EPA, IPM, P.O. Box 501, Bryan's Road, MD 20616, (703)557-5076.

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PESTICIDE (TRADE NAME) AND TARGET PEST	SHORT-TERM HEALTH EFFECTS	LONG-TERM HEALTH EFFECTS
Chlorpyrifos (Dursban™) Roaches	Acetylcholinesterase (AchE) inhibitor. Nausea, stomach cramps, vision problems, headaches	Peripheral neuropathy, behavioral changes, brain pattern disturbances
Bendiocarb (Ficam™) Roaches, ants, fleas	AchE inhibitor. Diarrhea, muscle twitching, blurred vision	Hyperactivity, eye problems. Untested for carcinogenity.
Acephate (Orthene™) Roaches, ants	AchE inhibitor. Headache, fatigue, flu-like symptoms	Possible human carcinogen. Reproductive effects.
Cypermethrin (Demon™) Roaches, ants	Allergic dermatitis, flu-like symptoms	Possible human carcinogen. Polyneuropathy.
Propoxur (Baygon™) Roaches, hornets	Potent AchE inhibitor. Diarrhea, nausea, headache	Probable human carcinogen.

Recycling In Schools: From Fad To Business

◆ By J. Winston Porter, Ph.D.

The recycling of solid wastes (garbage, trash) in schools will soon be here to stay in most areas. What used to be an "environmental activity" is becoming institutionalized due not only to the increasing environmental ethic, but to a variety of state and local laws requiring recycling. The U.S. Congress is also considering national recycling mandates.

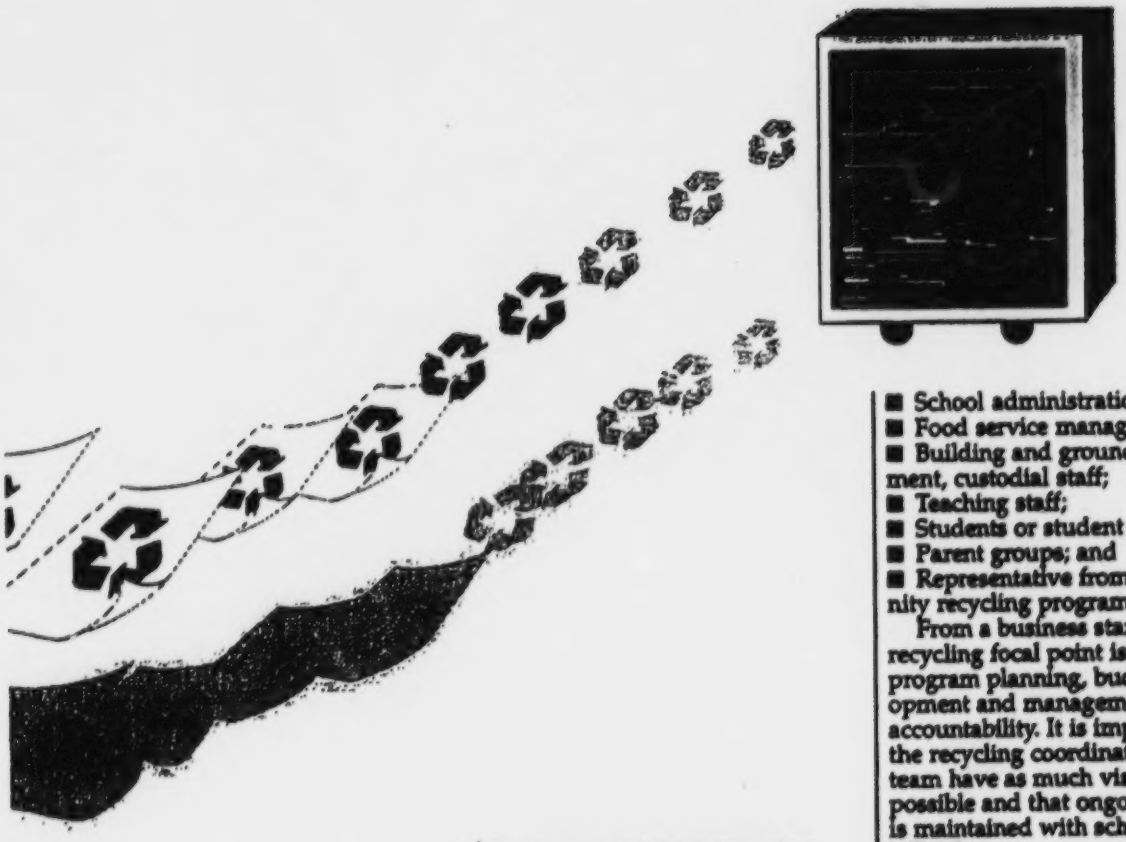
Recycling is no panacea to solve all of our solid waste problems. But it can be helpful in taking pressure off more traditional, and controversial, disposal methods. It can save resources and energy. It can save money for some materials in some locations, and school-based recycling provides an excellent educational opportunity for students in the areas of resources and waste management, and in the economics of supply and demand.

For the above reasons, I recently prepared a workbook entitled, "Setting Up A Solid Waste Recycling Program in Schools." I will draw from this how-to manual, as well as subsequent feedback from actual school or other recycling programs, to discuss the business aspects of recycling in schools.

Recycling is quite different from many environmental activities as the net result is not, say, treated wastewaters or reduced air emissions, but a product for sale. Thus, recycling is a business activity with traditional elements such as raw materials, processing steps, marketing and financial controls.

Because of its rapidly evolving nature, and the vagaries of such items as commodity markets, recycling is much less structured than other school businesses. Also, recycling in schools can take on several alternative shapes and sizes, including:

- A single-school program where all elements of materials collection, preparation and marketing are specific to that school;
- A school system recycling program to take advantage of multi-school hauling contracts or



larger amounts of waste materials to be marketed; and

- A gradation of both of the above in which the recycling program is a school-only activity or part of a community-wide effort.

Numerous business issues arise when organizing and implementing a recycling program in schools. Important questions include the appropriate program organization, deciding what materials to recycle, the selection of appropriate business partners, and various financial issues. These elements will all be discussed, ending with suggestions for achieving a successful recycling program.

Organizing The Program

In organizing a recycling program in a school, or school system, perhaps the first question to ask is, "Why are we recycling?" Answers can range from "the Environmental Club thought it would make a good project," to "it's the law in our area."

The motivation for recycling is important in determining the types of materials to recycle (some may be mandated!), the recycling goals to achieve for particular materials, and the anticipated longevity of the program. Figure 1 contains a simplified overview of key state recycling laws, illustrating the extreme diversity of such laws. It is, therefore, important to understand state recycling laws and regulations, as well as any local requirements.

In parallel with documenting the program rationale, a key step is appointing a recycling program coordinator and his or her team. A wide range of possibilities exist from teacher or student-based leadership to administration-directed programs.

The recycling program coordinator and team can be recruited from any section of the school community. Potential candidates include:

- School district administration (large systems);
- School administration;
- Food service management;
- Building and grounds management, custodial staff;
- Teaching staff;
- Students or student groups;
- Parent groups; and
- Representative from a community recycling program.

From a business standpoint, a recycling focal point is critical for program planning, budget development and management, and accountability. It is important that the recycling coordinator and team have as much visibility as possible and that ongoing contact is maintained with school business officials.

The role of the recycling coordinator includes the following responsibilities:

- Determination of items to recycle;
- Program initiation;
- Day-to-day oversight of recycling activities;
- Financial aspects;
- Continuing recycling education; and
- Ongoing evaluation and reporting of results.

Depending greatly on the size and scope of the recycling program, the recycling coordinator may range from a new, salaried position to an individual assuming this role in addition to his or her other activities. The important thing is for this person to be motivated and in a position to coordinate an often-popular, but somewhat complex operation.

Finally, it is important to note that the recycling leadership may evolve as the program is institutionalized. For example, a recycling program may start as a club activity, with the leadership changing to administrative staff as

the program grows into a permanent school function. Eventually, it is probably desirable that the recycling coordinator be housed with a complementary function (e.g. custodial services, maintenance and operations).

Deciding What To Recycle

A fundamental aspect of the program is choosing the materials to recycle. This first involves an approximate determination of the amount and type of potential recyclables the school, or system produces. A sample worksheet for developing this information is provided in Figure 2.

Some creativity is needed in determining the amounts of potential recyclables. In some cases, the approximate amount of waste items produced in a given time period can simply be collected and weighed (cardboard boxes may be an example).

For other items, an estimate based on the amount of the item purchased is probably a better approach. (Polystyrene foam food containers are an example.) The important thing is to get all items on a common basis such as pounds per month.

In parallel with determining the amount and type of potential recyclables, it is important to begin investigating markets for the more promising items. The term "market" does not always mean a direct purchaser, where money flows from a buyer to the school.

In some cases, the school may even have to pay someone to take a recyclable, or the recyclable may be transferred to a municipality or other organization without money changing hands. Thus, terms like market and purchaser may need to be interpreted somewhat broadly. They really imply a chosen recipient for the recyclable.

In assessing the marketability of recyclables, keep in mind:

- If your school doesn't produce a sizable quantity of waste material, or it can't be collected easily, the market demand for it is not too important; and
- On the other hand, if the school can easily collect a large amount of an item, but there is no significant market for it, it may not be feasible to recycle it at this time.

Determining what to recycle is not an exact science. However, an attempt should be made to develop the approximate economics of each potential recyclable Figure 3 is a suggested format.

In addition to this analysis, a number of subjective issues should be addressed, including:

- Is there enough of the material to interest a potential recipient?
- Can the school readily collect the material? Is extensive preparation of the item required?
- Is the community or some other organization already involved in recycling the item? Can the school join them easily?
- Does the future look good for continued recycling of the material?
- Can a profit be made, or at least

FIGURE 1
Statewide Solid Waste Management Goals

State	Source Reduction	Recycling[1]	Composting	Mandated	Deadline
Alabama				Yes	1991
California				Yes	2000
Connecticut	[2]		—	Yes	1991
District of Columbia	—		—	Yes	1994
Florida			—	Yes	1995
Georgia				Yes	1996
Illinois	—		—	Yes	2000
Indiana			—	Yes	2000
Iowa			—	Yes	2000
Louisiana				Yes	1992
Maine	—			No	1994
Maryland	—		—	Yes	1994
Mass.				Yes	2000
Michigan				No	2005
Minnesota	—			Yes	1993
Mississippi				Yes	1996
Missouri				Yes	1998
New Hamp.				Yes	2000
New Jersey	—		—	Yes	1990
New Mexico				Yes	2000
New York			—	No [6]	2000
N. Carolina				Yes	1993
Ohio			—	Yes	1994
Pennsylvania	—		—	Yes	1997
Rhode Island	—		—	Yes	1993
Vermont				No [6]	2000
Virginia	—		—	Yes	1995
Washington				Yes	1995

[1] Includes yard waste composting.
[2] Goal is no change in waste generation rate.
[3] 15% goal for counties under 100,000.
[4] 35% goal in the 70 county Twin Cities area; 25% in greater Minnesota.
[5] Does not include leaf composting as part of the goal.
[6] Goals were developed pursuant to the State Solid Waste Management Plan.
[7] Goal is to reduce the amount of waste generated.
[8] Ultimate goal is to recycle as much as possible.

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some of the current disposal costs be offset by recycling the material?
- Is recycling of the material legally mandated?

The idea is then to consider the economic and subjective factors to decide what items make sense to recycle now. The recycling coordinator and team are the likely parties to make this decision.

Selecting Your Business Partners

There are two major paths a school can choose in marketing its recyclables. Perhaps the easiest, if available, is to join an existing area-wide recycling program such as one run by the municipality in which the school resides. This may simply involve placing the recyclables in a location and manner prescribed by the area-wide program.

The second major option is to market the school's recyclables directly to recycling firms or other organizations. For example, the school might sell aluminum cans to an aluminum company, or cardboard boxes to a paper recycling firm. A variation of this approach is to sell to a recycling broker who will purchase one or more recyclables from the school and resell them to the actual recycler. Some schools deal directly with a hauling contractor who then deals with end users of the various materials

Smaller schools or systems often find it difficult to locate and deal with numerous recycling firms or organizations and thus find it advantageous to deal with a single hauler, or recycler. On the other hand, where feasible it is often better economically to market specific commodities to particular outlets. If it proves difficult to find local outlets for particular recyclables, it is important to note that several national organizations representing major commodities have their own lists of possible purchasers. Figure 4 contains some of the more relevant of these organizations.

In determining the organization(s) with whom to work, the following questions should be asked:
- Is the purchaser interested in your materials in the form and quantity you have?
- What special requirements does the purchaser have? For example, does cardboard need to be bound or bailed? What contaminants are forbidden for a particular recyclable?
- What services does the purchaser provide? Will the purchaser provide storage containers, for example?
- What type of time commitment does the purchaser expect from you? What type of commitment will the purchaser give on his part?
- What price does the purchaser offer? (As noted earlier, the recipient may expect you to pay him!) The important thing is that the price, and other key conditions, be clearly understood.

Finally, it is important to have a coordinated approach to all of the school's solid waste — both that which is to be recycled and that which goes to disposal. Some items may even move from recycling to disposal, or back again, as markets or other factors change. Thus, it is important that the recycling and "normal" waste disposal function be closely coordinated in order to deal with such issues as negotiations with firms who do both recycling and disposal, possible credits for recycling in hauling contracts, and disposal of wastage from recycling operations.

FIGURE 2
What Potential Recyclables Are Produced?

	Amount In School Trash (lbs/month)
School Offices	
Cardboard Boxes	_____
Other paperboard	_____
Newspapers	_____
White paper	_____
Mixed paper	_____
Classrooms	
Cardboard Boxes	_____
White paper	_____
Mixed paper	_____
Food Service	
Cardboard Boxes	_____
Other paperboard	_____
Polystyrene items	_____
Other plastics	_____
Steel cans	_____
Glass containers	_____
Aluminum cans	_____
Laboratories & Shops	
Cardboard Boxes	_____
White paper	_____
Mixed paper	_____
Library	
Cardboard Boxes	_____
White paper	_____
Mixed paper	_____
Newspapers	_____
Other	_____

Financial Aspects

A school, or system, will probably not achieve significant financial rewards through a recycling program. Some disposal costs may be reduced, and revenues may exceed expenses on a few specialized items such as aluminum or high-grade office paper.

However, through careful and creative management, the finances of a recycling program can be improved considerably. It is important, for example, to track the costs related to each recyclable so, over time, one can get a better handle on "winners" and "losers."

Also, recycling interacts with hauling contracts in a number of ways and it is important to creatively negotiate with such haulers. For example, many programs have realized no hauling cost reduction via recycling because the hauler's agreement calls for, say, picking up one dumpster per day — full or not.

Schools, like municipalities, may need to work toward hauling contracts that relate more to the actual pounds of trash hauled.

Another financial opportunity area has to do with marketing. Markets for recycled materials are in some cases well-developed (e.g., aluminum) and in some cases embryonic (e.g., plastics). But recycling is a growth business and market outlets will grow and evolve. It is important to stay abreast of markets for recyclables to maximize the return.

Greatly different prices are being offered for various materials depending on such factors as location and material quality. As with other materials and services, it is important to strive for competition.

A problem area with some school's recycling programs has had to do with "who keeps the money?" For example, if a particular school, or activity within a school, is able to sell a recyclable, can that school or activity keep the funds for its own use?

Some systems have said yes, some no. From a motivational standpoint, it's probably best to allow some revenues to be kept by individual schools or groups.

Suggestions For A Successful Program

As the above discussions illustrate, there are many factors in developing and maintaining a successful recycling program. In closing, a number of suggestions for a successful program are outlined.

First, keep it simple at the start. Don't begin with an overly ambitious program which may be so elaborate that it's hard to sustain. It's better to start with a modest program of about two to four recyclables and expand as knowledge is gained. By getting started soon, however, the school will be in much better shape to talk knowledgeably with local municipal officials about area-wide recycling.

Second, work closely with buyers, or other recipients. Interests in specific recyclables, and requirements for their prepa-

FIGURE 3
Recycling Candidate Form

1. Candidate material for recycling	_____	
2. Amount available to recycle	_____	lbs/month
3. Approximate net selling price	_____	$/lb
4. New costs for school to recycle this material	_____	$/month
5. Estimated net revenues (Item 2 x Item 3 - Item 4)	_____	$/month
6. Estimated savings from current practice (Item 2 x current hauling cost)	_____	$/month
7. Net gain or loss (Item 5 + Item 6)	_____	$/month

FIGURE 4
Key National Recycling Contacts

Paper & Paperboard
American Paper Institute. 1250 Connecticut Avenue. NW, Suite 210, Washington, DC 20036; (800) 878-8878

Plastics
The Polystyrene Packaging Council, Inc.. 1025 Connecticut Avenue. NW. Suite. 508. Washington, DC 20036; (202) 822-6424

Council for Solid Waste Solutions. 1275 K St., NW, Suite 400, Washington, DC 20005; 800-2-HELP90

Aluminum Cans
Aluminum Association. 900 19th Street. NW. Suite. 300. Washington, DC 20006; (202) 862-5100

Steel Cans
Steel Can Recycling Institute. Foster Plaza 10. 680 Andersen Drive, Pittsburgh, PA 15220; (800) 876-7274

Glass Containers
Glass Packaging Institute. 1801 K Street. NW. Washington. DC 20036; (202) 887-4850

ration, vary greatly around the country. Let potential purchasers or partners help in setting up a relevant program.

Third, involve the custodial and other staff early and often. It is particularly critical that the people who will actually do much of the work be included on the recycling team. Similarly, it is important to minimize the additional work needed to recycle.

Fourth, be sure to identify start-up costs. Some programs simply evolve without a clear indication of what costs will be incurred for items such as storage areas, collection containers, materials preparation (e.g., washing cans or binding paper), and pickup facilities.

Finally, education and convenience are major keys to success. The messages about the program should be clear and positive, and fairly easy to implement, or there will be a rapid "die-off" in enthusiasm and results.

Let me close by noting that most school populations are enthusiastic about recycling. This enthusiasm will be a valuable ally as business officials move to institutionalize recycling as an integral part of school operations.❑

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Healthy Buildings Keep Employees Out of Bed and Employers Out of Court

◆ By Dennis R. Dunklee, Ph.D., and Richard M. Silberman

In the February,1991 issue of School Business Affairs, I provided readers with an overview of litigation concerning "sick building syndrome." Recently, I had the opportunity to meet and discuss this phenomenon with Richard Silberman, a technical representative for a large international environmental consulting firm. The results of that meeting were enlightening from both the scientific as well as the legal perspective and Mr. Silberman agreed to work with me in providing this expanded look at providing healthy buildings and avoiding litigation.

— D.R.D.

In July 1968, in Pontiac, MI, 100 health department employees concurrently developed an unexplained malady characterized principally by fever, headaches, and muscular pains. Exhaustive laboratory and environmental investigations failed to identify the etiological agent. Eventually, the building was implicated and a defective air conditioning system was suspected as both the origin and transport mechanism of the causative microbe. The illness was simply labeled "Pontiac Fever."

In 1976, another mysterious illness resembling pneumonia struck 182 elderly people attending an American Legion Convention at a hotel in Philadelphia. The illness, subsequently named "Legionnaire's Disease," claimed 35 lives before the ordeal ended. In this instance, the disease was positively traced to a distinct strain of bacteria. Also, it was confirmed that the culpable bacterium was spread by the hotel's air supply and conditioning system. Legionnaire's Disease is now estimated to afflict between 25,000 and 45,000 persons each year in the United States alone.

The Legionnaire's catastrophe is generally regarded as the watershed event in ushering in what the media has dubbed "Sick Building Syndrome" (SBS). The prime cause of SBS appears to be poor indoor air quality. SBS is a misnomer since it is not the building which gets sick, but rather the people within it. SBS is usually defined as a situation in which at least 15-20 percent of a building's occupants exhibit physical symptoms in a pattern that is linked to the building in which they work. These symptoms seem to worsen as the day goes on, disappear upon departure from the building at the end of the day or for the weekend, only to reappear upon return to the suspect building.

Ironically, the landmark Legionnaire's case is really an example of what has come to be known as "Building Related Illness." Building Related Illness (BRI) differs from Sick Building Syndrome in that it results in a clinically defined illness or disease which does not resolve itself upon exit from the building and requires a prolonged recovery period. Since SBS is much more prevalent than BRI and impacts on considerably more people's day-to-day lives, focus is usually put on SBS when discussing healthy buildings.

Recently, nine employees became asthmatic shortly after they moved into a new office building and doctors suspected the workers were suffering from SBS according to testimony in *Perkins v. Matomic Operating Company*. Attorneys who represented the employees claimed that their clients' illnesses resulted from an unspecified bacteria or mold that contaminated the air they breathed while on their jobs, and that most of the affected employees did not have previous upper-respiratory problems prior to working in the building.

As a result of litigation, as well as scientific progress, public and private agencies have amassed enormous amounts of information about illnesses caused by air contaminants. As a result, a whole body of law involving the participation of doctors, engineers, industrial hygienists and environmental quality experts is evolving. Attorneys note that there are a number of SBS cases now pending across the country, and as these cases are resolved, more and more cases will be filed.

The United States Occupational Safety and Health Administration (OSHA) and the National Institute for Occupational Safety and Health (NIOSH) believe that illnesses such as those described in the Perkins case could be caused by contaminated building materials, microbiological contamination and inadequate ventilation.

In another recent case, *Beebe v. Burlington Industries*, plaintiffs contended that they became ill from fumes emitted from a new carpet in their office. Attorneys in this case also predict that as specific cases are litigated and won by plaintiffs, the floodgate will open and risk managers will be adding the cost of this type of litigation to their budgets if they have not developed a comprehensive SBS risk prevention plan.

Sick Building Syndrome

The symptoms of SBS occur in a common pattern among people, regardless of age, race, sex, geographic location, or other demographic variables. Symptoms begin in their mildest form with eye irritation, dry throats, runny noses, cough, and general upper respiratory irritation. As symptoms become more severe, nausea and mental impairments such as dizziness and an inability to concentrate can appear. Many of these symptoms mirror those of influenza or the common cold.

The onset of SBS is associated with the build-up, to critical levels, of indoor pollutants in a building. These levels will then cause irritation or illness, depending on the agents involved and the sensitivities of the particular occupants.

There are literally thousands of pollutants found at any time in today's indoor environments. They can be grouped into four main classifications: gases and vapors, fibers, dusts, and microbes. Among gases and vapors, the U.S. Environmental Protection Agency has studied over 300 volatile organic compounds in the indoor environment. Inorganic compounds include carbon dioxide, carbon monoxide, sulfur dioxide, nitrogen oxides, ammonia, and radon. Fibers in the air can come from clothing and other textiles, cotton, fiberglass insulation, and the notorious asbestos. Dusts are comprised of common household allergens, house mites, pollen, dander, and smoke from tobacco, wood, or coal. Finally, with the combined presence of dirt and stagnant water in the indoor environment, microbes such as bacteria, protozoans, fungi, and viruses can flourish.

Modern building interiors, supplies, equipment, furnishings, detergents, pesticides, paints and lacquers, and even humans themselves can all contribute to the build-up of these different pollutants. What makes the diagnosis and cure of a sick building challenging is the overlapping symptomology of these different pollutants. Any one indoor pollutant can be responsible for any of the previously mentioned symptoms associated with SBS.

Health Effects Associated With Sick Building Syndrome

Though it is unknown exactly how many buildings today are "sick," the problem is commonly regarded as widespread and nondiscriminatory by geographical location or climate. The World Health Organization estimates that 30 percent of all new and remodeled buildings suffer from SBS. Other studies suggest even higher figures.

What is known is that the symptoms associated with SBS are extensive throughout the population and expensive to U.S. businesses and public entities. Studies have shown that upper respiratory tract infections account for over half of the acute conditions afflicting the U.S. labor force.[1] Furthermore, these illnesses are responsible annually in the U.S. for over 150 million lost workdays and $15 billion in medical care costs to employers.[2] Certainly, employees miss work for a variety of reasons and not all upper respiratory illness is caused by spending time in unhealthy buildings. But there is a growing body of evidence which suggests a strong link between upper respiratory diseases and the buildings in which we now spend over 90 percent of our time.

"Attorneys note that there are a number of sick building syndrome cases now pending across the country, and as these cases are resolved, more and more cases will be filed."

Perhaps the most conclusive evidence of this link was an exhaustive study done by the Walter Reed Army Institute over a four-year period of time (1983-1986). During this study, approximately 400,000 recruits were housed in two very different kinds of buildings. Half lived in what are considered energy efficient buildings; i.e., the windows are sealed and there is very little infiltration of outside air through other means. The other half were housed in non-energy efficient buildings; i.e., the windows could open, and there was much outside air infiltration through cracks and seals. Upon careful study of the recruits' health over the four years, it was revealed that acute respiratory disease rates were approximately 50 percent higher among those living in the energy efficient, or "tight" buildings. Clearly, the Walter Reed study showed that a building's ventilation plays a major role in the likelihood of that building becoming a sick building.

Factors and Causes of Sick Building Syndrome

Hard data is only now beginning to be compiled as to which

[1] *See generally, National Center for Health Statistics (December, 1989)*

[2] *See generally, Garibaldi & Dixon, American Journal of Medicine, March 1985)*

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are the most common indoor pollutants associated with SBS. Healthy Buildings International, Inc., an environmental consulting firm specializing in indoor pollution, retains indoor pollutant information in a continually updated database. The database results from indoor air quality investigations conducted around the world in almost 700 buildings comprising 103 million square feet. The data reveals that the primary indoor pollutant found contributing to SBS is fungi, followed by airborne dust. Low relative humidity, the third most pervasive problem, is not itself a contaminant but rather a situation which makes the human body more susceptible to other pollutants through the drying of mucous membranes. Other frequently found pollutants include bacteria, formaldehyde, fibrous glass, exhaust fumes, and tobacco smoke.

There are three main causes which allow indoor pollutants to build up in a building to intolerable levels:

- Insufficient ventilation;
- Inadequate infiltration; and
- Poor HVAC system hygiene.

Insufficient ventilation in a building is the primary cause of SBS. Ventilation is defined as the replacement of stale recirculating indoor air with outside air. After the oil crises of the 1970s, energy costs skyrocketed. Economic pressures were brought to bear on architects and engineers to design buildings which were more efficient and tighter. This translated into structures with sealed windows. Similar pressure bore on building managers to adopt building operation strategies which minimized the introduction of outside air to the occupied spaces. The environment within these buildings was now hospitable for the omnipresent pollutants to quickly and steadily accumulate to critical levels, with little chance of adequate dilution.

Inadequate filtration includes both poorly fitted filters as well as inefficient filters. A building's filtration system is designed to remove sufficient numbers of particulate matter from both recycled air and outside air before it is brought inside. Good filtration must remove adequate amounts of the smaller-sized particles which are most apt to find their way into a human's pulmonary system. Often in a building, large gaps are left in a filter bank, or cheap non-efficient filters are mixed with quality filters. Both situations are tantamount to having no filtration at all, since air will follow the path of least resistance, and in both cases, the air will rush through either the gap or the non-efficient filters (bypassing the quality filters along the way).

Poor hygiene practices within a building's air supply and distribution system provides an unfortunate opportunity for air to pick up pollutants as it moves from outside via the air handling system, through ductwork, and eventually to occupied spaces. Since water (from condensation and/or humidification) and dirt are both present in a building's HVAC system, the system is a fertile breeding ground for microbial growth. Spores and other fragments from microbial growth, fibers from shredded internal insulation, and accumulated dirt throughout the system can all enter a passing air current and find their way to occupied spaces. Since a building's air handling system and associated duct work are unseen and hard to access, proper maintenance is often given low priority.

"There are three main causes which allow indoor pollutants to build up to intolerable levels: insufficient ventilation, inadequate infiltration; and poor HVAC system hygiene."

Economics of Healthy Buildings

The issue of increased ventilation and the ensuing rise in energy costs can be a delicate one to building trustees. It is obvious that conditioning outside air will be more expensive than recirculating already conditioned return air. However, when the impact of poor ventilation on employee absenteeism is taken into account, increased ventilation makes for a sound business decision for the building trustee.

Consider a 100,000-square-foot building in a moderate climate, urban area. That building might have an annual utility bill of approximately $150,000 ($1.50 per square foot), one-third of which ($50,000) could be attributable to heating, cooling and ventilation. If, through a reduction in ventilation, the HVAC portion of the bill could be reduced 25 percent (a very liberal estimate), this would translate into an annual savings of $12,500. Unfortunately, the following year's budget would be developed seeking a repeat of this energy saving performance, and the building would be locked into a minimal ventilation program.

Now consider the labor cost implication of the same building. If it is assumed one employee per 150 square feet, this building would have 667 employees (100,000/150). At an average annual compensation of $30,000 per employee, the annual payroll costs associated with the building would be $20 million. For most organizations, payroll represents the largest cost associated with doing business. Every 1 percent of avoided absenteeism through an improvement in the indoor environment translates into annual payroll savings of $200,000. This figure dwarfs the energy savings previously calculated through a reduced ventilation policy.

It is important to reiterate that not all absenteeism is due to SBS. However, it is now clear that the buildings in which people spend so much time, and the state of

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their operation and maintenance do have a profound impact on the probability that they will suffer from the upper respiratory illnesses which lead to job absenteeism.

Implications for Risk Management

Implication 1 — The proliferation of media attention and public awareness about the topic of healthy buildings has spawned a new industry in the environmental services field. Government agencies, private consultants, HVAC contractors, industrial hygienists, and medical technicians all provide services to promote healthy buildings. Much of the work of these professionals is limited to reactive investigation. That is, they will react to a client who has a suspected SBS problem and respond accordingly. Knowledgeable building trustees recognize the value of proactive monitoring of their building's air quality even when they have no reason to believe that a problem exists.

Implication 2 — A competent indoor air quality firm should be experienced in this specialized field and have access to a wide range of expertise including microbiology, chemistry, engineering and HVAC design. Because of SBS's overlapping symptomology, it is important for a professional to treat the building as one whole system, any one part of which can affect another.

This holistic or "building systems" approach to SBS attempts to avoid zeroing in on any particular pollutant, and instead, focuses on building conditions which allow any or all pollutants to accumulate.

Implication 3 — A prudent indoor air quality investigator will conduct an extensive inspection of the building's air handling and distribution system, as well as extensive sampling and analysis of the various pollutants commonly encountered. During the inspection, particular emphasis will be given to the design and operation of the air handling systems, ventilation rates, control systems, filtration, and the state of the internal ductwork. Contaminant sampling and analysis must always be conducted to reach definite conclusions regarding the building's ventilation, filtration, and HVAC system hygiene.

Implication 4 — In the majority of cases, the effort to attain a healthy building is limited to the time when the building is a settled entity, teeming with occupants going about their business on a daily basis. However, there is now a budding movement in the building industry to pay attention to the issue of healthy buildings at the design and construction stages of a building's life.

This approach recognizes the benefits of prevention over cure in treating building system ailments. Often such a strategy can prevent SBS problems before the building is occupied and an operating history is established. Such foresight also sets the foundation for a permanently healthy building and lessens the chances of SBS problems developing later during its occupied life (provided there is still a sound building maintenance and operation program in place).

Implication 5 — There are many indoor environmental issues to be considered when performing a preoccupancy study toward the design of a healthy building. These issues include:

- The original design of the building and its HVAC system;
- Use of interior materials and physical plant that will be durable and maintainable over time;
- Use of interior products which will not contribute to indoor pollution;
- Proper building commissioning procedures; and
- The establishment of a reliable, proactive indoor air quality monitoring program when the building starts to become occupied.

Implication 6 — School district risk management officials should make certain that a district's buildings, offices and maintenance shops:

- Follow a standard plan of preventive maintenance for all air exchange systems including the cleaning or replacement of filters on a scheduled, and recorded, basis;
- Use non-toxic cleaning and painting materials;
- Have proper ventilation; and
- Have appropriate fuel and solvent storage equipment in maintenance and industrial arts facilities.

In addition:

- Caution should be exercised in carpet selection, especially if glue is going to be applied to affix carpeting to a floor;
- Prior to any new construction or renovation, contractors should be questioned about materials that have been identified by various agencies as possible air contaminants; and
- Cost or minimum size specifications should not be a factor in determining the selection of air-exchange equipment.□

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Working Together to Clear the Air

Integrated indoor air quality management

By Stuart Flatow

The headline reads, "Congressman Says Students Are Dropping Like Flies." This statement was in reference to a string of fainting spells which occurred last spring at a Northern Virginia high school. A second headline reads, "Only Schwarzenegger Could Handle This School," (Indoor Pollution News, p. 8) and refers to a New Hampshire elementary school that had to be closed down due to poor indoor air quality (IAQ) but remained open long enough for Arnold Schwarzenegger to make his scheduled presentation to promote May as National Health and Fitness Month. Ironic, isn't it?

Occurrences such as these are becoming commonplace throughout North American school systems. Often, as was the case in the Northern Virginia high school, no definite causes are established for the rash of fainting spells despite extensive investigations.

Concerns over IAQ have propelled the topic into the forefront of work place problems of the late 1980s, and as we move through our second year in the 1990s IAQ is still one of the top public health concerns. As the public becomes more aware of the health and comfort implications of IAQ, pressure will increase on commercial, private, and public buildings to maintain a healthy air supply.

IAQ problems not only have a potential impact on health, they also affect the learning process, creating a special concern for schools, their staff and their students. (Maryland State Department of Education/Anne Arundel County Public Schools) (MSDE/AACPS), 1989).

The Random House College Dictionary (1972) defines the term integrated, as used in this article, as the "combining or coordinating of separate elements so as to provide a harmonious, interrelated whole." Thus, bringing together all of the departments in a school system who are in one way or another responsible for the comfort and well being of its occupants becomes the main management task in creating an integrated management system (IMS) to respond to IAQ concerns. Organizing and utilizing the information generated by the program is the second management task.

This article discusses the requirements and the management and communication skills needed to develop an integrated IAQ program in public schools to respond to, identify, remedy, and hopefully prevent IAQ-related health concerns among school occupants and the community.

Creating and Defining IMS

A systematic management approach which views and understands the "big picture" of its organizational goals is more effective than one that responds to individual incidents on a crisis management basis in which various departments have their own pieces of unshared information. "Since it is clear that the problem (poor IAQ) is not often traceable to a single source or contaminant, but rather to multiple problems in the design, construction, operation, and maintenance of a building" (USEPA, 1990, p. 13), interaction in the form of communication and sharing of information between departments may effectively avoid misdiagnosing IAQ concerns and undertaking inappropriate remediation activities.

For example, an IAQ episode may be blamed on a malfunctioning air handling unit when in reality the system's design criteria may not have been sufficient to begin with. Often personnel may not be aware that the unit is operating as it should be but is automatically turned off by a centrally located energy management computer system.

Establishing lines of communication between departments is a difficult task. Drucker (1974) states that, "Communications has proven as elusive as the unicorn" (p. 481). All too often other departments and building occupants are not aware of renovations and building designs provided by construction personnel; safety and health personnel may not be aware of maintenance activities such as painting or pesticide applications which can lead to serious IAQ episodes; principals and

teachers may not be aware of ventilation and thermal guidelines controlled by energy management personnel or on the proper procedures of operating unit ventilation systems in their classrooms; school-based plant operations personnel may not be knowledgeable on how to operate or maintain newly installed, state-of-the-art heating, ventilation and air conditioning (HVAC) equipment; and business managers may not be made aware of IAQ concerns or remediation activities. Such a lack of communication can result in confusion, delays, wrong conclusions, and animosity.

Simply communicating the message that we all need to work together may not be enough. "The effectiveness of an information system depends on the willingness and ability to think through carefully what information is needed by whom and for what purposes" (p. 489). Communicating the definition of the IMS as an interdepartmental sharing of information and knowledge to produce a systematic method of responding to and preventing IAQ problems would be the first managerial announcement presented to all those involved.

Thus, one can think of the IMS as consisting of separate specialized modules which are in control of their own performance and work together with other modules, by sharing information, for its main objective, the quality finished product. In this case, the finished product being a sound IMS to respond to IAQ concerns, where the modules consist of the separate specialized school-support and school-based departments and personnel (Drucker, 1974).

Implementing and Organizing the IMS

Solving IAQ problems affect and involve various school-support services, management, school occupants, and community groups. The task now is to implement the management program and to create a school-wide organization to deal with IAQ. To provide such a program, three elements are needed — management support and commitment, staffing, and budgetary allocations (MSDE/AACSS, 1989).

Since many departments involved in an IMS program do not usually work directly with one another or share each others' budget, they may feel threatened to come together as one organization. The need for managers to alter their communication, problem solving, and planning skills will have to be considered in order to avoid conflicts. Otherwise, department heads may not want to "go the extra mile" to implement or participate in the IMS due to resistance to change.

This is why a commitment from upper management is necessary for implementation of the IMS. Upper management must point out that these changes are needed in order to foster better departmental communications of issues. Upper management must stress that IMS will have a positive impact on all departments and that all departments will be able to participate and be involved in the project (Daft, 1983).

"Bringing together all of the departments in a school system who are in one way or another responsible for IAQ concerns is the main management task in creating an integrated management system (IMS)."

The following describes the job functions of the various departments, how they may communicate with one another, and their impact on IAQ and the IMS.

The departments include Safety and Health (often under an umbrella office of Risk Management), Construction, Energy Management, Maintenance, Plant Operations, as well as school-based business managers.

Safety and Health

Larger school systems usually have a separate Safety and Health Department (SHD) which is often looked to for guidance and assurance during and following IAQ episodes. SHD interacts with third-party consultants and government agencies and communicates health risks, if any, to school occupants.

SHD personnel need to be aware of all planned renovations, maintenance activities, energy management policies, and any special occupant activities which may affect IAQ. This may be accomplished by attending departmental meetings, with an opportunity to comment on planned activities that may have a detrimental impact on IAQ.

When an IAQ concern is communicated to the SHD, the department should conduct a preliminary investigation as soon as possible so that the concern does not linger. Identification of the concern can start with brief discussions with faculty, building service personnel, and business managers.

The quick response of the SHD may not only resolve ongoing and unsolved occupant concerns, it may present an opportunity to communicate technical information in a manner which can be understood. For example, a teacher may feel that there is "something growing" in his/her classroom which is causing upper respiratory discomforts. Explaining that it may be the low humidity in the classroom (especially during winter months) that is the cause of the discomfort rather than microbial growth, is easily understood, especially when shown on a temperature/humidity meter. This type of communication provides a secure feeling and a sense of goodwill between building occupants and the SHD.

If SHD personnel feel that the cause of the IAQ concern is of a mechanical nature, maintenance personnel should be contacted and given the information gained during the preliminary investigation so that proper repairs or re-

placements can be more easily diagnosed. SHD personnel should accompany maintenance to see first hand what the mechanical problems might be and how they are to be remedied. This gives the SHD investigator the entire picture of the cause and solution to the IAQ concern which can then be communicated to building occupants.

Construction

The fate of IAQ may often begin at the design phase of newly constructed and renovated schools. Building designs should take into consideration air flow patterns, local climate, occupancy patterns, and occupant activities. Access to HVAC equipment for maintenance purposes must also be considered. For example, installation of access panels into pipe cases and duct work may negate the need to tear down or dismantle parts of a structure in order to locate and remove biological contamination or debris accumulation. If access panels are installed, their location needs to be communicated to building service, maintenance, and SHD personnel.

Due to overcrowding at many schools, portable classrooms are often used. These classrooms may be especially susceptible to mold growth and foul odors. There must be assurances that these structures are properly installed, insulated and ventilated, and underlaid with water-tight plastic vapor barriers. Care must be taken when these buildings are transported to avoid structural damage which can invite potential IAQ problems.

When buildings are renovated, their configuration may change from an open space design to a closed one, often resulting in interior classrooms with no windows. Corresponding renovations to the HVAC system must be an integral part of the renovation project if IAQ problems are to be prevented.

Discussing planned construction activities with other departments can allow for input which may prevent IAQ problems. Other items of discussion may be the potential impact of conducting roofing operations during building occupancy, or the proper location of thermostats. Construction personnel can lend support to other departments by providing blueprints and as-built drawings which can give clues as to the potential sources of IAQ concerns.

Energy Management

We are all aware of the high cost of energy and the need to stem these costs through energy conservation. However, these cost savings ought not be at the expense of occupant health. Energy management (EM) personnel may be instrumental in the design and commissioning of energy saving HVAC devices that are centrally controlled by computer systems which dictate when and at what rate ventilation is provided. Although these devices can reduce costs, their design may leave some classrooms with inadequate ventilation which can increase contaminant loads and decrease comfort levels.

Some specific HVAC recommendations for achieving energy management and acceptable ventilation include estimating the number of classroom occupants, selecting the HVAC system that will provide a continuous high rate of air exchange, providing filtration for the removal of microorganisms, using demand controlled ventilation to save energy, and maintaining humidity levels at close to 30 percent. (Wheeler and Abend, 1991).

To effectively avoid IAQ episodes, there should be ongoing communication between EM personnel and school personnel. If a school plans to conduct after-hour operations, such as a play or sporting event, EM must be made aware of this ahead of time so that increased ventilation can be provided.

EM personnel can provide support during IAQ episodes by determining if energy management system (EMS) controls are working properly. For example, the EM computer may indicate that an outside air damper is opening as scheduled. If the damper is found to be closed, it may be due to a mechanical problem rather than an EMS problem. Conversely, a closed air damper may be due to a computer programming oversight or EM policy. This type of information sharing can save valuable time in trying to find out what the IAQ concern is.

EM can also provide personnel to assist in conducting IAQ investigations and in explaining the EMS to building occupants.

Maintenance

Maintaining healthy air quality requires timely and ongoing maintenance of HVAC, plumbing, electrical and structural systems. Maintenance personnel are often the middlemen between construction and school-based plant operations personnel and may be the first department employed by the safety and health department when IAQ problems arise.

As with SHD, maintenance may respond to IAQ concerns based on information given to them by plant operations personnel. Faulty thermostats, missing fan belts, overheating classrooms, and roof or plumbing leaks are just a few examples of the types of items that would be brought to their attention. Whenever possible, maintenance and plant operations personnel should conduct building audits together to be used as a baseline to anticipate IAQ problems. Major building areas to be evaluated include the roof, HVAC system, plumbing, basement/crawlspaces, and other areas such

"Maintenance personnel are often the middlemen between construction and school-based plant operations personnel and may be the first department employed by the safety and health department when IAQ problems arise."

as food services, copy rooms, laboratories, vocational shops, and storage facilities (MSDE/AACPS, 1989).

All work orders sent to maintenance involving IAQ-related concerns should be copied and sent to SHD to let the IAQ investigator know there is a problem that needs to be looked into. Whenever maintenance personnel conduct operations such as painting, school principals should be given prior notice to allow them to inform staff and parents

Pesticide application may also fall under the purview of maintenance and should be conducted only by licensed applicators using as low a toxicity pesticide as possible. Although the school itself may be occupied, applications within specified areas should occur only during periods of non-occupancy. As with some other maintenance activities, affected areas should always be ventilated using fans or windows rather than HVAC systems to avoid contaminating the system. The SHD department should always be notified of pesticide use. The principal also needs prior notification in order to give occupants the option of being absent during the applications.

Plant Operations

The plant operations department consists of personnel who actually operate and maintain school HVAC and boiler systems (plant operators) as well as conduct general maintenance and housekeeping (building service workers). Many times plant operations personnel are the first to learn of IAQ concerns. If the concern is thought to be due to a mechanical malfunction or structural damage that they cannot repair, work orders for corrective action should be sent to maintenance immediately. If the concern is one which needs an immediate response, such as a chemical spill or a fainting spell, the SHD department should be called immediately.

Plant operators may be transferred from one school to another with little or no knowledge of how the HVAC equipment at the new school operates. Some systems may be so complicated that even a trained engineer may have difficulty understanding them. To be effective, plant operators must be given extensive hands-on training on how to operate and troubleshoot sophisticated equipment, preferably by an operator who thoroughly understands the system.

Building service workers should be trained in the identification of potential and actual biological contaminants as part of their preventive maintenance activities. They need to be aware of the proper use and nature of cleaning chemicals to avoid their misuse from becoming a source of IAQ episodes.

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Business Managers

The business manager in smaller school districts may play a large role in communicating and managing IAQ concerns. They may contact government officials or third party consultants for guidance and remediation, and they may be the overall point of contact for all school district personnel involved in IAQ episodes.

This "wearing of many hats" may impede an effective IMS. To help avoid this, business managers should be made aware of all planned operations conducted within his/her facilities and have established points of contact with maintenance or construction personnel in the event of HVAC malfunctions or other possible emergencies.

Most importantly, the business manager should "know" his/her building. Regardless of the size of a school system, business managers are usually responsible for knowing all operations conducted in the building. As with plant operations personnel, they are often the first to learn about IAQ concerns. If they have equipment malfunctions, roof leaks, chemical spills, or other occurrences, they (business managers) can usually provide this information to the appropriate department.

Business managers may also have a "feel" for the attitudes and desires of the occupants. For these reasons, they should also be included in all pre-construction, renovation, maintenance, and energy management planning sessions in order to provide insight on occupant sensitivities, activities, and past and present IAQ concerns. This type of input can prevent IAQ concerns by giving building occupants some of the health-related items they desire, such as windows that open. It also allows for an accurate flow of information from the business manager to the occupants regarding construction plans so that occupants can make special arrangements which may prevent IAQ episodes.

Collecting, Analyzing, and Communicating Data

Once the IMS players are organized and willing to work together, the overall manager of this program must be able to organize the information and personnel in a way that meets the program's objective of integrating provisions for energy conservation, preventative maintenance, building design standards, and health maintenance of students and staff (USEPA, 1990).

Data collection may begin with school profiles which indicate some of the mechanical and structural components of the school. Safety and health personnel can maintain an ongoing list of all chemical products used at schools through the use of Material Safety

Data Sheets (MSDS) which indicate the various potential hazards associated with the products.

Follow-up inspections at schools with previous IAQ concerns should be made by SHD, maintenance, and plant operations personnel to ensure that the old problems have not reoccurred and to prevent new problems from occurring. Such re-inspections can breed good will between the departments, school occupants, and community groups.

The key to obtaining and using data is to hold regular meetings with all IMS department heads and upper management. Field personnel such as plumbers, HVAC mechanics, electricians, building service workers, business managers and even principals should also be encouraged to contribute information and suggest remedial actions during these meetings. These gatherings can identify problem schools and prioritize response actions that maximize limited resources while solving IAQ problems.

Detailed documentation in the form of written investigative reports compiled by the SHD department during and after IAQ episodes can be used to establish IAQ complaint trends, similarities, and causes. They can also be used to determine the effectiveness of remediation procedures. Following this sharing of information, all participants should be encouraged to make suggestions as to how to improve the IMS. To be truly effective and valid, suggestions should get the approval from upper management before being acted upon.

All of this ongoing communication between support service departments and school-based personnel will allow the IMS to monitor its effectiveness in responding to and preventing IAQ problems. Similar to Statistical Quality Control (SQC), how and how often the IMS can be improved depends on obtaining input from those personnel and faculty who have hands-on experience in working with the program. This line of communicating information can be used to continually improve on the program (Drucker, 1990).

Conclusion and Comments

EPA's IAQ activities are based on authority provided by Title IV of the Superfund Amendments and Reauthorization Act (SARA) as well as the Toxic Substance Control Act, the Federal Insecticide, Fungicide and Rodenticide Act, and the Safe Drinking Water Act (USEPA, 1990).

Presently, there are no enforceable IAQ regulations. A bill pertaining to IAQ legislation sponsored by Representative Joe Kennedy, D-Mass., may change that and require building owners and administrators to take a more pro-active role in IAQ concerns. Additionally, it would seem that when government agencies such as the EPA have separate IAQ divisions and are forming IAQ guidelines, regulations seem more probable than not (Indoor Pollution News, 1992).

Since it would seem inevitable that legally enforceable IAQ standards will be forthcoming, an insightful manager need not wait for such an impetus to start creating a well coordinated program to act on this issue. Most school systems do have the specialized personnel needed to implement a successful IMS. Managers must establish the leadership needed to organize these programs in order to accurately recognize and respond to potential IAQ-related health threats to school occupants, especially children.

"Ongoing communication between support service departments and school-based personnel will allow the IMS to monitor its effectiveness in responding to and preventing IAQ problems."

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There's Something in the Air

Indoor Air Quality in Schools

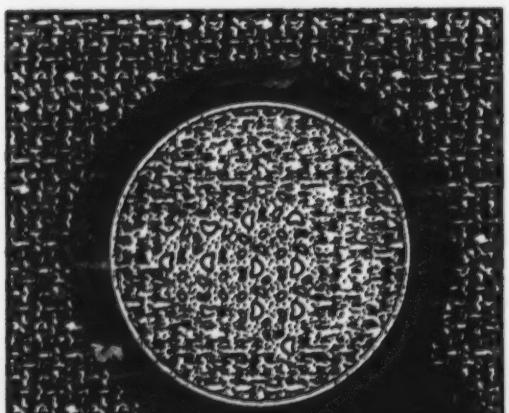
By Edward A. Schmidt, MPH, CIC

Air quality has been of some concern for hundreds of years, but it has received major attention for only the past 40 years, beginning with the Clean Air Legislation of 1955. However, almost all emphasis has been placed on outdoor air quality.

The problems associated with smog, industrial air emissions, automobile exhaust emissions and acid rain have been well known for years. The practice of open burning has been virtually eliminated in many areas and incinerator use has been curtailed or eliminated in some areas as well. The strict air emission requirements mandated by the Clean Air Act in 1991 further restricted incinerator use. Thus, the topics of air pollution and outdoor air quality are familiar to us.

However, indoor air quality is a relatively new area of concern. The majority of Americans spend 90 percent or more of their time indoors. Obviously, indoor air quality (IAQ) should have been of great concern to us for at least as long as there has been concern about outdoor air pollution.

We should also be aware of the distinction between the effects of outdoor air pollution and the effects of indoor air pollution. Outdoor air pollution primarily affects the environment; it has a lesser effect upon health. However, indoor air pollution is almost exclusively associated with health problems. Because of this, we see IAQ becoming more "popular," if such a term is appropriate, because of concern expressed by public health organizations, consumer advocate groups, unions, the news media and the public in general. This last category certainly includes parents who are concerned about the effects of school-building IAQ on the health of their children.



Editor's Note: This is the first in a three-part series of articles which discuss indoor air quality (IAQ) issues affecting schools. Part 1 will provide a general overview of IAQ; Part 2 will look at the effects of carpet maintenance and environmental influences on IAQ; and Part 3 will look at carpet use in schools and compare the IAQ ramifications of carpet versus hard surface floors.

The Onset of Recognized IAQ Problems

Following World War II, the use of cheaper alternative materials, such as pressed wood and plastics, replaced the use of traditional building materials and furnishings. There was also an increase in the development and use of pesticides, synthetic personal care products and cleaning materials, many of which were applied through the use of aerosols.

Following the energy crisis of

the early 1970s, more and more air-tight buildings were designed to conserve energy. With the advent of these tight buildings, evidence began accumulating that IAQ was causing some problems for building occupants. This is because these buildings no longer allowed the free exchange of indoor and outdoor air. They permitted pollutants to build up to levels higher than previously experienced.

But IAQ problems have not been restricted to tight buildings; they have been discovered in most types of buildings. Inadequate ventilation has been the major cause of IAQ problems because of either insufficient design capacity or improper operation and maintenance of the heating, ventilation and air conditioning (HVAC) system.

The increased use of synthetics, changes in construction technology and modification of ventilation rates have contributed to increasing numbers of complaints and reports of adverse health effects related to IAQ in homes, schools and the work place.

These have all led to an increased recognition of the importance of IAQ in maintaining the health of building occupants. This recognition has been further heightened by sensationalistic media coverage, "investigative" reporting and by public misperceptions about IAQ and health.

Adverse Health Effects

As IAQ has become better known, so have some terms associated with the health effects related to poor IAQ. It is important to understand these terms. The three major health problems associated with IAQ are Sick Building Syndrome (SBS), Building-Related Illness (BRI) and Multiple Chemical Sensitivity (MCS).

SBS is a persistent set of loosely-associated symptoms that occur in greater than 20 percent of those exposed, with the cause(s) frequently unrecognizable. Symptoms commonly associated with SBS include: eye, nose and throat irritation or dryness; nasal and sinus congestion; difficulty in breathing or shortness of breath; cough; dizziness; nausea; nose bleeds; headache; fatigue or lethargy; skin irritation or dryness; irritability; and reduced mental activity. Complaints or symptoms are relieved upon exiting the building but can recur upon reentry to the building.

SBS may be suspected essentially by perception and the diagnosis of SBS can be based primarily on the exclusion of other diagnosable diseases. Studies have suggested that a single unifying cause for SBS is unlikely and that it is more likely to be due to "multifactorial" causes. The building may be poorly designed, improperly constructed, inadequately maintained or a combination of these. But remember, it isn't the building that is "sick," it is the occupants who become sick.

In contrast to SBS, BRI results from exposure to indoor air pollutants and is well documented with defined diagnostic criteria, recognizable causes and defined treatments. Upon leaving the suspect environment, people with BRI will usually require prolonged recovery times and remedial action. Prevention usually requires elimination of exposure to the causative agent(s). Examples of BRI include Legionnaire's disease, hypersensitivity pneumonitis (inflammation of the lung due to biological or chemical agents), allergies and humidifier fever.

Chronic, potentially fatal diseases, such as cancer, asbestosis, emphysema and heart disease, can result from exposure to indoor air pollutants, such as radon, asbestos, environmental tobacco smoke and organic chemicals.

In the case of Multiple Chemical Sensitivity (MCS), there is controversy as to the real cause of the illness. On one side clinical ecologists classify MCS as an acquired environmental illness related to low-level exposures to chemicals that do not cause harmful effects in the general population. On the other hand, some people attribute MCS to psychological causes or "behavioral sensitization." The true nature of MCS remains to be determined.

Indoor Air Pollutants

There are many sources and types of indoor air pollutants that have been associated with adverse health effects. There are hundreds of contaminants that can be placed into several general categories: biologics or biogenic agents, volatile organic compounds (VOCs), combustion products, respirable particles, respiratory products, radionuclides and odors associated with any of the above.

Biologics or biogenic agents include viable or non-viable forms of bacteria, fungi, viruses, amoebae, algae and pollen grains. They also include insect parts and wastes; plant parts; animal saliva, urine and dander; human dander; and organic dusts. Bacteria and fungi, including their spores and toxins, are frequent causes of IAQ problems, primarily in moist environments or where water has been introduced, such as by flooding.

Plant pollen and spores are frequent causes of allergic responses. Dust mite feces are predominant allergens in the home. In the past, biogenic agents have primarily been of concern to physicians, mainly allergists and pulmonary specialists. It is only recently that IAQ concerns about biogenic particles have been of major interest to nonmedical investigators, lagging behind their interest in other contaminant concerns.

VOCs are major problem sources as are formaldehyde, lead and radon. Problems associated with asbestos are also well known. Environmental tobacco smoke is a well documented source of many health problems and contains many different hazardous combustion byproducts.

Carbon monoxide from internal combustion engines continues to cause problems where there is inadequate ventilation or engine exhaust mixes with

the incoming air. Excess carbon dioxide in occupied classrooms and offices (due to inadequate ventilation) can cause headaches, lethargy and reduced mental activity, certainly less than ideal environments for students or office workers. Odors are also important because people often associate a "bad" odor, whatever it may be, to a harmful source, i.e., if it smells bad, it must be bad.

Psychogenic factors may also be important and should not be overlooked. Psychogenic factors result from psychological stimuli such as odors or suggestion and can cause SBS. This may be especially evident in schools because children are very impressionable. The author has investigated IAQ complaints in school districts in several states and observed that there were frequently more complaints from children in classrooms where the teachers were also vocal about IAQ complaints.

There is a dynamic interaction between biological, chemical, physical, social and organizational factors (including stress). This is true for all human health effects, including indoor environmental complaints. Therefore, the role of social and organizational factors cannot be overlooked. Psychosocial or psychogenic factors may play an important role in SBS, but they may not have caused the original problems.

Sources of Indoor Air Pollutants

After looking at the multitude of air pollutants, we can ask the question, "Where do they come from?" We have already seen that building construction materials can be major sources. Next we can look at the interior furnishings and the furniture, supplies and machines.

Plywood and chipboard or pressed wood furniture are major sources of formaldehyde. Copy machines produce ozone. Various office, custodial, maintenance and classroom supplies produce VOCs. Human activity can produce respiration byproducts, notably carbon dioxide. Perfume, cologne, deodorants, etc., produce VOCs.

Pesticides that are applied indoors or that are applied outdoors and migrate indoors are a source of VOCs and toxic chemicals. Biologic agents, including microorganisms, animals, plants and insects are sources of toxins, allergens and VOCs. Soil is the source of radon. The outdoor air may contain pollutants, including VOCs, microorganisms, pollen and others.

These are only some of the sources for specific pollutants. The sources for microorganisms in the indoor environment are also significant. Most of the bacteria on indoor environmental surfaces and in indoor air result from human occupancy. Most of the fungi in the indoor environment result from outdoor air rather than from human sources When indoor bacterial counts are unusually high or when indoor fungal counts are much higher than outdoor air counts, we can look for indoor sources (amplifiers) where bacteria or

fungi might be growing.

We all shed about 10,000 viable microorganisms per minute and about 95-97 percent of those which are not retained in our clothing end up in the environment and settle onto upward-facing horizontal surfaces, primarily floors. Very small particles, microbial and otherwise, tend to remain airborne. For example, a particle of one micrometer (micron) diameter size will settle out of the air at a rate of only about six inches per hour, but particles as small as 10 micrometers in size, about one-fifth the diameter of a human hair, will settle out of the air rather rapidly at a rate of about six inches per minute. The significance of particle deposition onto upward-facing horizontal surfaces will be seen when the carpet sink effect is discussed in Part 2 of this series.

Physical Factors Affecting the Perception of IAQ

The physical environment can affect building occupants and produce symptoms that may be blamed on poor IAQ. The primary physical factors to be considered are temperature, relative humidity, lighting, noise and vibration.

Since symptoms are nonspecific, different causes can lead to an increase in the same symptoms. For example, excess noise, intense lighting with glare, thermal discomfort and air pollutant exposures can all lead to headaches, irritability and fatigue. Building design, construction and maintenance should insure that the temperature and the humidity are not too high or too low, that lighting is not too intense or too low, that there is no excessive noise and that occupants are not subjected to constant vibration due to equipment or machinery operation.

The Effects of Ventilation on IAQ

The National Institute of Occupational Safety and Health (NIOSH), and the U.S. Public Health Service, conducted health hazard evaluations in public access buildings and identified the most frequent sources of IAQ problems (Figure 1).

The results of a survey of 813 buildings from 1980 to 1992, reported by Healthy Buildings International, Inc., found the most significant pollutants or contributing factors and the major causes of problems associated with these pollutants or factors (Figure 2).

Ventilation plays a significant role in not only providing good IAQ, but in also preventing IAQ-associated complaints and illnesses. HVAC systems must be of sufficient design capacity to meet the needs of the building, and they must be properly constructed and maintained. The HVAC system provides two major functions: it reduces the concentration of pollutants; and it conditions the air.

The HVAC system reduces the concentration of pollutants by:

- Providing sufficient ventilation rates (air changes per hour).
- Providing fresh air makeup.
- Providing filtration.
- Providing local exhaust.

There must be sufficient air exchanges and fresh air makeup

FIGURE 1
Most Frequent Sources of Indoor Air Quality Problems

Inadequate ventilation	50 percent
Indoor contamination	19 percent
Outdoor contamination	11 percent
Microbial contamination	5 percent
Building fabric contamination	4 percent
Unknown	11 percent

FIGURE 2
Most Significant Indoor Air Pollutants and Their Causes

The most significant pollutants or contributing factors:	
Allergenic fungi	33.4 percent
Dusts	26.6 percent
Low relative humidity	18.5 percent
Allergenic or pathogenic bacteria	10.2 percent
Formaldehyde	8.5 percent
Fibrous glass	6.6 percent
Vehicle exhaust fumes	5.6 percent
Volatile organic compounds	4.1 percent
Tobacco smoke	2.8 percent
High relative humidity	2.1 percent
Ozone	1.0 percent
The major causes of problems associated with these pollutants or factors were:	
Operating faults/poor maintenance	75.6 percent
Inefficient filtration of air	56.9 percent
Poor ventilation due to energy conservation	54.1 percent
Poor air distribution	20.8 percent
Design errors	16.5 percent
Contamination inside ductwork	12.2 percent

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to insure that air pollutant levels are maintained at an optimum low level. Ventilation rates and fresh air makeup requirements will be different for a classroom where carbon dioxide buildup may be the only concern as opposed to a maintenance shop or laboratory where additional harmful chemical buildups could occur.

Sufficient filtration must be provided to insure that pollutants in the outdoor fresh air makeup or in the recirculated air are removed before the air is supplied to the ventilated areas. Local exhaust should be provided where there is a potential for the generation of harmful pollutants, such as in welding operations and laboratories.

Air is conditioned by providing temperature and relative humidity control. The temperature should be maintained in a comfort zone that will be acceptable to occupants. The relative humidity must be maintained in a mid-range where it is acceptable to occupants but does not support microbial growth. If the humidity is too low, it can cause symptoms such as dry nose and throat, coughing and dry skin. If the humidity is above 60 percent, it can support the growth of bacteria and fungi. In addition, the temperature and humidity should be balanced. For example, if the temperature is on the high side of the comfort zone and the humidity is high, the result is physically uncomfortable. However, at the same temperature and a lower humidity, the result would be acceptable.

Whenever there are complaints about IAQ, the HVAC system should be checked first and environmental sampling should be a last resort. As the NIOSH evaluation showed, inadequate ventilation is the single most important cause of IAQ problems.

Summary

Concerns about IAQ and IAQ-related complaints and illness are receiving ever increasing emphasis, and this will continue. The subjects of SBS, BRI and IAQ problems have evolved into a volatile mixture of science, medicine, engineering, politics, economics, emotions and news media sensationalism.

There are many factors that can influence IAQ and the perception of IAQ. These may be biological, chemical, physical, psychosocial and organizational, or a combination of these. Therefore, there may not be a single factor that is solely responsible for inadequate IAQ or IAQ-related problems.

However, inadequate ventilation is the most frequent cause of IAQ problems. IAQ concerns can be greatly reduced in the properly managed building. Conversely, the best designed and constructed building can have IAQ problems if it is not properly maintained and managed.

Now that we have had an overview of IAQ and indoor air pollution in a broad sense, we will look at some specific questions about IAQ in schools and other buildings with respect to carpet in part two of this series of articles.□

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Bugs in Your Rugs?
Carpet Maintenance and Indoor Air Quality

By Edward A. Schmidt, MPH, CIC

Carpet has sometimes been implicated in indoor air quality problems, both with Sick Building Syndrome (SBS) and Building Related Illness (BRI). Formaldehyde from new carpet was once a problem, however, formaldehyde has not been used in carpet manufacture for 13 years. Odors and volatile organic compounds (VOCs) from carpet can be easily reduced by airing new carpet before installation. However, the "new carpet smell" and the history of new carpet problems may frequently outweigh the reality. It is this perception of new carpet problems that frequently dictates how consumers and the public react.

There is no question that moist carpet, like any other moist environment, will support the growth of bacteria and fungi. In the absence of moisture, bacteria and fungi cannot grow.

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They may persist for some time, depending on the type, but they will not increase in numbers. Therefore, moisture control is an important part of carpet maintenance since dry carpet cannot add to the microbial load of the environment. The consumer and the public at large need to be educated about the necessity for maintaining a dry carpet.

The news media is also a source of negative opinions about carpet. This may frequently be due to misinformation, over zealous "investigative" reporting, preformed perceptions or bias. In any case, public perception is frequently based upon media reports, right or wrong.

Public misunderstanding is a very potent factor as well. A relatively recent example was a proposal to ban the use of carpet in New York state buildings because of a hazard introduced when two carpet installers improperly used non-carpet adhesive, not because of any risk associated with the carpet itself.

Because of these misperceptions, it is essential to establish good scientific data relating to carpet use. Likewise, carpet use must be evaluated under realistic use conditions.

Carpet and IAQ

To better understand the use of carpet, we must look at the reasons for carpet cleaning and maintenance. Carpet has traditionally been cleaned for aesthetic reasons. People want their carpets to look good. However, the main reason for cleaning carpet is, or should be, for health.

Dr. Michael Berry of the U.S. Environmental Protection Agency (EPA) and others are promoting carpet maintenance for health reasons, and rightly so. For 20 years, I have defended carpet use in hospitals and elsewhere on the basic premise that properly maintained carpet does not constitute a health hazard. So the concept is not new, but it is finally being recognized and advocated on a widespread scale.

In 1985, the U.S. Center for Disease Control and Prevention (CDC) stated, "Recommendations against use of carpets in patient-care areas have been removed, since there is no epidemiologic evidence to show that carpets influence the nosocomial [hospital-acquired] infection rate in hospitals; whether to use carpets, therefore, is not considered an infection control issue."

Carpet is equally acceptable in schools so long as it is properly maintained. But we can't overlook the consumer's perception that a carpet that looks clean is clean and a carpet that looks dirty is dirty. Once again, we can see the importance of

educating the public, as well as certain sectors of the medical and scientific communities, on the relative safety of carpet use and the importance of routine cleaning.

Carpet acts as a sink and collects and entraps soil, microorganisms, plant and fungal spores, pollen, chemicals and other allergens. Entrapment in the pile of the carpet restricts the redissemination or resuspension of the materials back into the air. However, it is essential that this sink be emptied periodically before it overflows, i.e. the carpet must be cleaned regularly.

Interest Groups

There are many interest groups in both the public and private sectors which influence what people think about carpet.

The EPA is looking closely at the effects of carpet on IAQ in all settings. The final regulatory impact of this investigation is uncertain. EPA's initial concern over the effects of carpet on IAQ stemmed from reports of adverse health effects on EPA employees after new carpet was installed at the EPA headquarters building. While there were other contributing factors to the employees' illnesses, including the building itself, it was the carpet that received the initial blame.

The Occupational Safety and Health Administration (OSHA) is also looking at IAQ. Unions are strongly urging OSHA to develop an IAQ standard because of the sheer number of people working and living in public and commercial buildings. OSHA solicited public comment about an IAQ standard but the direction that OSHA will take has not been finalized.

The Office of Management and Budget review process may seriously impair IAQ regulations, so that may delay or hamper any regulation. In addition, federal OSHA standards do not usually apply directly to public employers and employees; however, as with the OSHA Bloodborne Pathogens Standard, appropriate state agencies usually adopt the OSHA standard and apply them to schools and other public employers.

The Carpet and Rug Institute (CRI) has taken an active stance in defense of carpet use, as would be expected, and is sponsoring carpet research related to IAQ. Cleaning organizations, carpet mills, and fiber producers are also looking at various aspects of carpet installation and care.

A few years ago, the American Conference of Governmental Industrial Hygienists (ACGIH) Bioaerosols Committee set out to establish IAQ bioaerosol test methods and standards. Test methods were developed but the committee finally decided that they could not and would not continue to try to develop standards because of the multitude of variables that influence test results.

Various information sources can also be important to both the professional's and the lay person's knowledge and perceptions about carpet use. Sources include reference books such as EPA guidelines and references, recognized standard test methods, periodicals such as *Indoor Air Review* and *Indoor Air Bulletin*, journal articles, and professional IAQ conferences or seminars.

With all of the groups interested in the subject, it is no wonder that the effect of carpets on IAQ is a hot topic. And this is only the beginning. IAQ, in all of its aspects, will continue to be of major concern. For this reason, the effects of carpet maintenance on IAQ must be addressed.

"With all of the groups interested in the subject, it is no wonder that the effect of carpets on IAQ is a hot topic."

Studies on the Effects of Carpet Maintenance on IAQ

What are some of the effects of carpet cleaning and maintenance on IAQ? Several groups are trying to answer this question, including the EPA, the CRI and professional cleaning organizations.

In response to the need for scientific evaluation of carpet and carpet maintenance, a national cleaning service firm began to evaluate carpet and IAQ in 1991. The primary goal was to measure the effects of carpet maintenance on IAQ in various building environments, with the relatively simple hypothesis that good carpet maintenance improves IAQ. The following is a brief summary of the research, a discussion of the variables influencing research and the results.

Research studies were conducted in three types of buildings; elementary schools and junior high schools, private residences and office areas in the company headquarters building. Ongoing follow-up studies in these environments, as well as in other environments such as day-care centers, nursing homes and hospitals, are either taking place or are planned.

Tests were conducted to determine the levels of particles in the air, bacteria and fungi in the air, bacteria and fungi in the carpet pile, bacteria and fungi on hard surface floors, dust mite feces in the carpet, and volatile organic compounds (VOCs) in the air. Recognized and accepted sampling and test methods were used, and results were analyzed statistically. Specific information on test methods is available from the author.

All testing was conducted under actual use conditions and no attempt was made to alter the variables which existed. Standard carpet cleaning and maintenance procedures and schedules appropriate for each environment were used.

Effects of Variables on Test Results

Whenever environmental sampling is conducted, and air sampling in particular, it is important to recognize the variables and other influences that affect any interpretation of the results. There is no way to control all of the variables unless testing is conducted in chambers with controlled environments. Therefore, under actual use conditions, one must try to reduce the number of variables and then recognize the effects of the remaining variables when test results are analyzed. Some of the variables or influences relate to the buildings, building occupancy, environmental conditions and the carpet.

The building influences can be attributed to the design and construction, such as "tight" buildings; the preventive and corrective maintenance programs; the heating, ventilation and air conditioning (HVAC) systems; and the intended and actual uses of the buildings.

The influences of the building occupants are extremely important variables, as will be seen later. The types of activities and the traffic within buildings, and the types of occupants will influence results, e.g. school children versus nursing home residents.

Environmental variables may completely override the effects of the test components themselves. The time of the year introduces vastly different outdoor and indoor conditions from hour to hour, day to day, week to week, and so on. The geographical location will also influence the conditions at various times of the year. The specific locales, such as inner city versus suburban versus rural will also introduce variables.

There can be variables due to the carpet itself such as its design, construction and age. Carpet maintenance procedures and schedules certainly influence results, and the type of room, building or environment where the carpet is installed can determine the effects introduced by the carpet.

Clearly, the interpretation of results is not as straightforward as we would like it to be or as some people think it should be. This will become evident as the tests and results are discussed.

School Carpet Studies

Three types of studies were conducted in schools. The first study was conducted in two elementary schools in two different school districts, using one classroom in each school. School A was maintained under a national custodial management service contract and School B was maintained by a small independent contractor. Carpets were vacuumed nightly. Sampling was conducted at each school for ten school days in the morning before occupancy and at the lunch break immediately after the rooms were vacated. Outside air conditions were equivalent on each sample day.

The second study compared IAQ in a junior high school and an elementary school in the same school district. An interior classroom was studied in each school. Samples were taken for five days before the school year started when there was minimal occupancy and activity, and for five days immediately after school started when there was maximum occupancy and activity. Carpet was vacuumed nightly once school began. Sampling was done before occupancy in the morning and at noon during both sampling periods. Outside air conditions were equivalent on each sample day.

The third study compared a carpeted versus a hard surface classroom, and this study will be discussed in the final part of this series of articles.

In all schools studied, the HVAC systems were run under reduced power at night to conserve energy and turned back up to full power about two hours before occupancy (about one hour before air sampling was conducted).

Study Results

In the first study, bacterial counts at the two schools were equivalent and showed increases at noon. This was expected since most bacteria found indoors result from shedding by human occupants. Fungal counts were higher in School B. These differences in fungal counts may be due in part to the variables associated with the two buildings and the carpet, as well as the impact of the difference in the carpet maintenance effectiveness.

Airborne particles were counted in six different sizes simultaneously, including the respirable size range of about 0.3-5.0 micrometers. The effect of human occupancy was not as evident with airborne particle counts as it was with bacterial counts. Airborne particle levels were lower in School A, most likely due to the same reasons as the microbial counts, i.e., differences between buildings, carpet and carpet maintenance. More than 90 percent of airborne particles were in the very small 0.3-0.5 micrometer size range.

Microbial carpet sampling yielded relatively low counts. There was much more visible soil on the sample plates from School B. This is most likely due to differences in the carpet and in vacuum cleaning efficiency.

In the second study, microbial air counts before and after school began demonstrated once again the effects of building occupancy and activity, HVAC operation, and carpet maintenance.

In both studies, microbial counts were different but the average number of microorganisms per cubic foot of air was relatively low for this type of environment (less than 13) and the air counts recovered to even lower levels by the following morning. This was likely due to decreased generating sources (people) and activity at night, the effect of the HVAC systems, and the nightly vacuuming to remove organisms that could be resuspended into the air by activity.

In the second study, airborne particle counts taken before the school year began were significantly higher in the early morning than at noon. This was most likely due to the effects of the HVAC systems. After school began, counts were significantly

lower in the morning as compared to noon. This reflects the effects of increased occupancy and activity. In addition, carpets were vacuumed nightly after school began, whereas they were not before school started.

Airborne particle counts were higher in the first study, most likely due to different seasons of the year with different climatic conditions, differences in HVAC systems and buildings, and the benefit of recent carpet extraction cleaning prior to the second study. The influence of environmental variables was readily evident.

Microbial carpet counts in the second study again showed the effect of human occupancy and carpet maintenance. Counts recovered to starting levels each morning, largely due to vacuuming and the HVAC systems. While counts were different in both studies, trends were the same.

Volatile organic compound sampling was done in all of the studies concurrently with the other air sampling. In all cases, the levels of VOCs in the air were very low, well below generally recommended limits.

Conclusions

We have discussed the results of different testing protocols in different school buildings with different characteristics and occupancies. The question remains — "What does this all mean?" After reviewing our results with EPA scientists, we agreed on the following conclusions:

- There was a good demonstration of the carpet sink effect with the results indicating that it improves IAQ.
- There were noted differences in IAQ that can be attributed to differences in carpet maintenance. It is apparent that effective carpet cleaning and maintenance have a positive influence on IAQ.
- There is no good information on dose-response relationships between SBS or BRI and IAQ in general. However, since we know that IAQ does influence illness, it follows that improved IAQ lessens the chance for IAQ-associated illness to occur. Our results demonstrated that carpet maintenance can provide a potential health benefit by improving IAQ to an optimum achievable level.

We have now seen how carpet maintenance can affect both the carpet and IAQ, and how a variety of influencing factors can affect any tests conducted under actual use conditions. In Part 3, we will discuss the subject of carpet versus hard surface floors in schools.□

"Our results demonstrated that carpet maintenance can provide a potential health benefit by improving IAQ to an optimum achievable level."

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Carpet vs. Hard Surface Floors

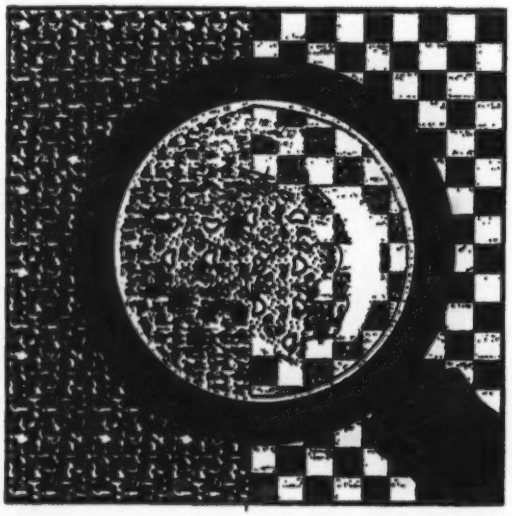
Studies Compare Health Effects of Each

By Edward A. Schmidt, MPH, CIC

As we have seen in the previous two articles in this series, interest in indoor air quality (IAQ), sick building syndrome (SBS) and building-related illness (BRI) has skyrocketed in the past several years. As this interest has increased, there has also been concern about the safety of indoor carpet. Some of the concern is related to the use of formaldehyde in carpet manufacture prior to 1978 and the misconception that formaldehyde is still present in new carpet.

Much of the concern is actually due to inadequate ventilation and moisture control rather than the inherent characteristics of the carpet itself. Inadequate carpet installation or carpet maintenance has also contributed to some of these concerns. Many of the reports of adverse health effects attributed to carpet are anecdotal and do not have a sound scientific basis. Regardless, the question remains, how does carpet compare to hard surface flooring from the IAQ perspective?

There have been relatively few scientific studies conducted to directly compare carpet and hard surface floors, and most of those were conducted in the 1960s and 1970s. Where such studies have been conducted, most evaluate carpet in the hospital setting, not in schools or other public buildings.



In the 1960s, Dr. James Shaffer and coworkers compared carpeted versus hard surface floors in a large hospital in the Midwest. Testing continued at this hospital, and I updated the data collected during the mid-1970s. In the early 1980s, Dr. Roger Anderson and coworkers at the Centers for Disease Control (CDC, now known as the Centers for Disease Control and Prevention) compared carpet and hard surface flooring in hospital patient rooms. In 1992, I conducted an extensive evaluation comparing air quality and surface quality in a carpeted classroom and a hard surface classroom.

Hospital Comparison Studies

The Shaffer studies were conducted in patient areas where environmental variables were controlled as much as possible, e.g., the same ventilation system, the same types and numbers of patients, and the same basic traffic patterns. These studies compared microbial air quality and microbial surface quality in carpeted and hard surface areas, synthetic versus natural carpet fibers, and varying maintenance

Editor's Note: This is the third in a three-part series of articles which discuss indoor air quality (IAQ) issues affecting schools. Part 1 provided a general overview of IAQ; Part 2 looked at the effects of carpet maintenance and environmental influences on IAQ.

schedules. In summary, it was found that:

- The airborne bacterial counts were related to the maintenance schedule used in the carpeted areas.
- With an appropriate schedule, airborne bacterial content in carpeted areas was equal to or lower than that in similar areas that were not carpeted.
- The vacuum cleaner was shown to be just as effective in reducing the bacterial count on the surface of the carpet as was wet mopping on the tile floor.
- There appeared to be no need to use disinfectants on the carpet unless this was to be a part of the shampooing process.
- No evidence was found to indicate that there was any remarkable difference between the synthetic and natural carpeting.
- There was no evidence to indicate that reservoirs of microorganisms were developing in carpet.
- There was no indication that any change in the incidence of hospital-acquired disease had occurred during the period of study.

According to the authors, there seemed to be ample evidence that the effect of any type of floor covering, e.g., carpet, vinyl tile, terrazzo, etc., on the microbiological aspects of the environment depends not on the nature of the material but on the nature of the care used in its maintenance.

The update I did on data collected in the early 1970s, in the same areas studied by Shaffer, yielded similar results and conclusions. The most important consideration was that there were no significant differences in the hospital-acquired (nosocomial) infection rates between the carpeted and hard surface areas. There were significant increases in bacterial air counts during the summer months each year in both the carpeted and the hard surface environments due in part to increased hospital construction which takes place during the warmer season in northern climates. However, the hospital-acquired infection rates remained essentially the same throughout each year, independent of the fluctuating bacterial air counts.

In the CDC hospital study, the carpet yielded higher microbial counts than the hard surface floor. However, the carpet was only vacuumed three times per week to maintain aesthetic appearance while the hard surface floor was wet-mopped daily with a disinfectant-detergent. Even with an inadequate carpet vacuuming, there was no hospital-acquired disease associated with the use of carpeting.

"The carpet and hard surface comparison conducted by the author indicated that there is no valid reason why carpet is not appropriate for schools...."

School Comparison Study

Would these findings hold true in schools? I compared the environments in a carpeted classroom and a hard surface science laboratory before classes started in the morning and during the noon break over a two-week period. The carpet was vacuumed nightly and the hard surface floor was damp-mopped with a disinfectant-detergent nightly by the custodians. The evaluation included sampling for airborne bacteria and fungi, airborne particles, surface bacteria and fungi, and airborne total volatile organic compounds (TVOCs).

In summary:

- Airborne microbial counts were significantly lower before occupancy than after occupancy in the carpeted classroom, while they were equivalent before and after occupancy in the hard surface classroom. However, airborne microbial counts were very low, ranging from one to seven per cubic foot of air in the carpeted classroom and from two to three in the hard surface classroom.
- Airborne particle counts were significantly lower in the carpeted area than in the hard surface area, generally about one-half the hard surface area counts.
- Bacterial counts at the carpet surface and upper pile were significantly lower than at the surface of the hard floors.
- Fungal counts were maintained at consistently low levels at both the carpet surface and upper pile and at the surface of the hard floors.
- All TVOC samples in both classrooms were very low, well below generally recommended limits. When the effects of confounding variables were considered, there was no significant difference in airborne microbial sampling results between the carpeted and hard surface classrooms. Fungi result primarily from outside sources and the consistently low levels of fungi seen at the surfaces were due in part to the good carpet and hard surface maintenance programs. While significantly lower airborne particle counts seen in the carpeted classroom may have been partly due to variables, there is a reasonable likelihood that the difference was largely due to the inability of the hard surface to entrap and retain particles.

Conclusions

The carpet and hard surface comparison studies conducted by Shaffer, Anderson and others indicated that the use of carpet in hospitals has no impact upon hospital-acquired infections and that proper carpet maintenance is a key factor. As mentioned in the previous article in this series, the CDC removed the recommendation against the use of carpet in patient-care areas of hospitals in 1985 because there was no evidence that carpets influenced hospital-acquired infections. The carpet and hard surface comparison conducted by the author indicated that there is no valid reason why

carpet is not appropriate for schools, as well as for the hospital environments that have been studied.

Proper carpet maintenance is essential regardless of the type of building or environment where it is installed, just as proper maintenance of hard surface floors is essential. There are some areas in schools where carpet is obviously inappropriate because of high spillage or soiling, such as kitchens, restrooms, industrial arts shops, loading docks and warehouses, etc. However, carpet is suitable for most areas in schools and public buildings.

There is good evidence that the decision on carpet use should not be based solely on the microbiological quality or indoor air quality aspects. There are other benefits to carpet use that should not be overlooked:

- Carpet is safer because it is more slip resistant and it has a cushioning effect if falls do occur.
- Carpet acts as an acoustic insulator and is quieter than hard surface flooring.
- Carpet provides an insulation and energy conservation effect, especially on cement slab construction.
- Carpet is more comfortable to walk or stand on, especially for prolonged periods of time.
- Properly maintained carpet provides for better indoor air quality, primarily as a result of the sink effect.

In the final analysis, it can be concluded that carpet is appropriate for use in schools when it is properly maintained.□

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Survey Reveals Environmental Protection's Growing Impact on the Maintenance Industry

The environment has become a key factor affecting professional end-users in the workplace. According to a study released by S.C. Johnson Professional, a division of S.C. Johnson & Son, Inc., 60 percent of end-users think complying with environmental laws and regulations takes too much time (and most are not strongly confident in their ability to keep up) which may inhibit them from doing more.

The survey—among a national sample of professional end-users from health care, building management and education—reveals growing interest in proactive environmental initiatives and regular activity to protect the environment.

Commenting on the survey, Bill Freund, vice president of S.C. Johnson Professional - North America, said, "What we've found is that end-users are spending a significant amount of time—up to one-fifth or more of their day—trying to comply with environmental regulations, and many feel confused and burdened."

"This research hones in on the specific environmental and safety concerns, and related compliance areas creating the greatest challenge to end-users. In doing so, it enables us to help ease their biggest challenges, so they can do even more environmentally. For instance, some of the concerns about cleaning product ingredients in general, and the impact on the environment once disposed, indicates better education and training around proper use and disposal of products could alleviate any misperceived concerns. That's something we can act on now."

Greater Environmental Awareness

A comparison to two previous studies shows end-users today are far more environmentally active than they were just 3-4 years ago, and more likely to participate in environmental behaviors in the workplace than the general public is at home.

In 1991, S.C. Johnson Professional commissioned qualitative research among building service contractors (BSCs) that revealed both limited environmental concern and action at that time. However, the 1991 survey participants expressed the belief that pending government regulation would soon require an increase in environmental activity in the maintenance industry. The results of this latest study confirmed the validity of that prediction.

A 1992 study from The Roper/Starch Organization, "Public Attitudes and Individual Behavior: North America," also commissioned by S.C. Johnson & Son, Inc., uncovered a high level of environmental concern and a lower level of personal environmental activism among the populations of the United States, Mexico and Canada. Most of the environmental behaviors listed in the Roper study were done on a regular basis by 25 percent or less of the general U.S. public, while half the behaviors in the end-user study were done regularly by 40 percent or more of those survey participants.

Additional Findings

Specific findings include:

- Eliminating the use of perceived toxic ingredients and producing low environmental impact products and packages are considered the most important action manufacturers can take for the environment.
- Providing cleaning staffs with written procedures for handling and using cleaning materials was selected as one of the most helpful changes to improve the quality of the environment for end-users organizations, mentioned by 58 percent of respondents.
- Most end-users take some regular action to protect the environment: 69 percent have an in-house recycling program; 58 percent review Materials Safety Data Sheets before making purchase decisions; 54 percent purchase floor finishes and cleaning products that are water-based rather than solvent-based, and

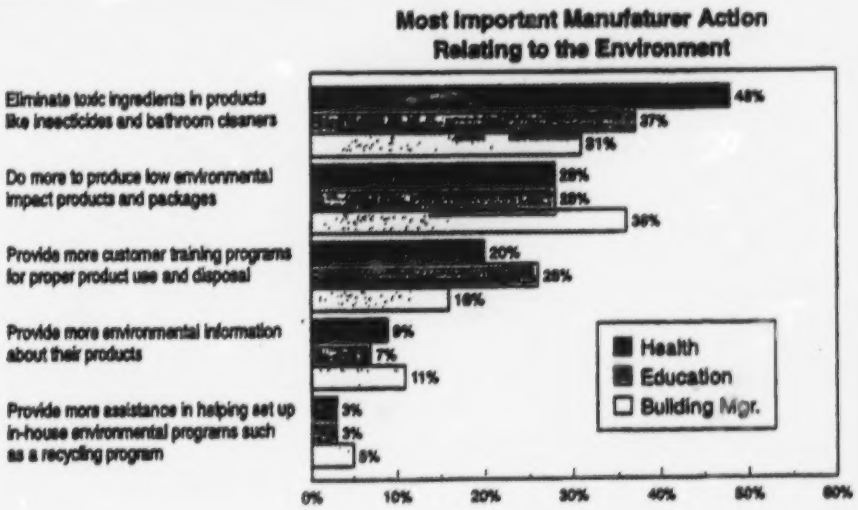
50 percent avoid buying certain products or ingredients if unsure about their environmental impact.

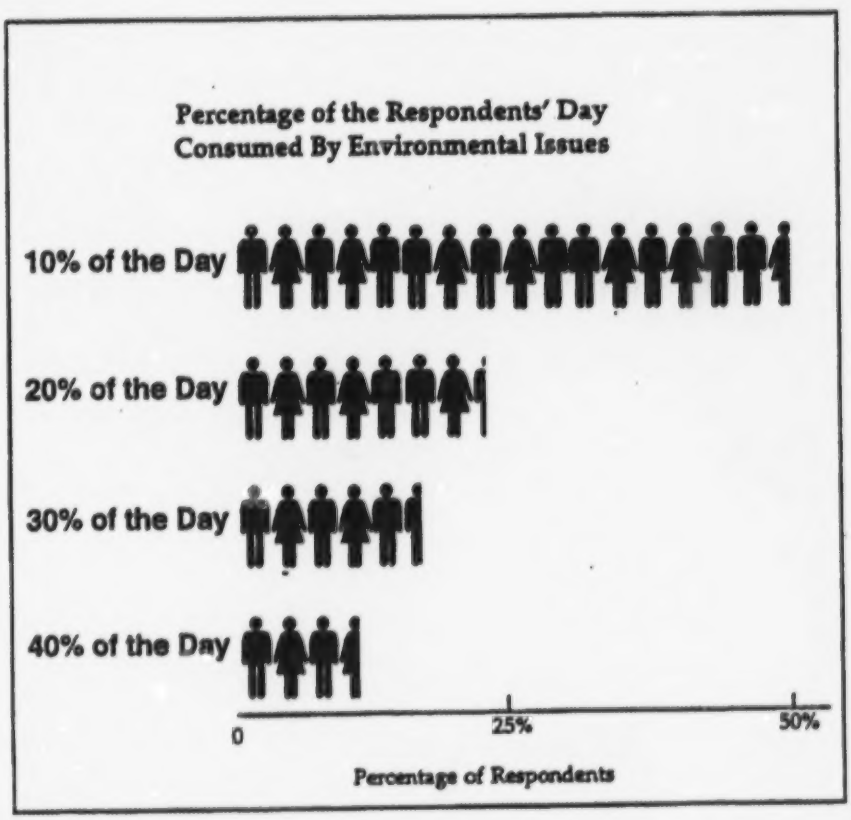
■ Survey participants' focus on ingredients over packaging to solve environmental problems indicating end-users' concerns towards chemophobia—fear of chemicals. Real and perceived concerns over exposure to chemicals in the workplace may be affecting end-users' environmental attitudes and actions.

How the Survey Was Done

Research supplier PERT Survey Research polled the housekeeping chemical purchase decision-maker from a representative sampling in each end-user group in early 1994.

Eleven multiple choice questions gauged environmental attitudes and workplace behaviors to provide insight into specific product and service needs among professional end-users.





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